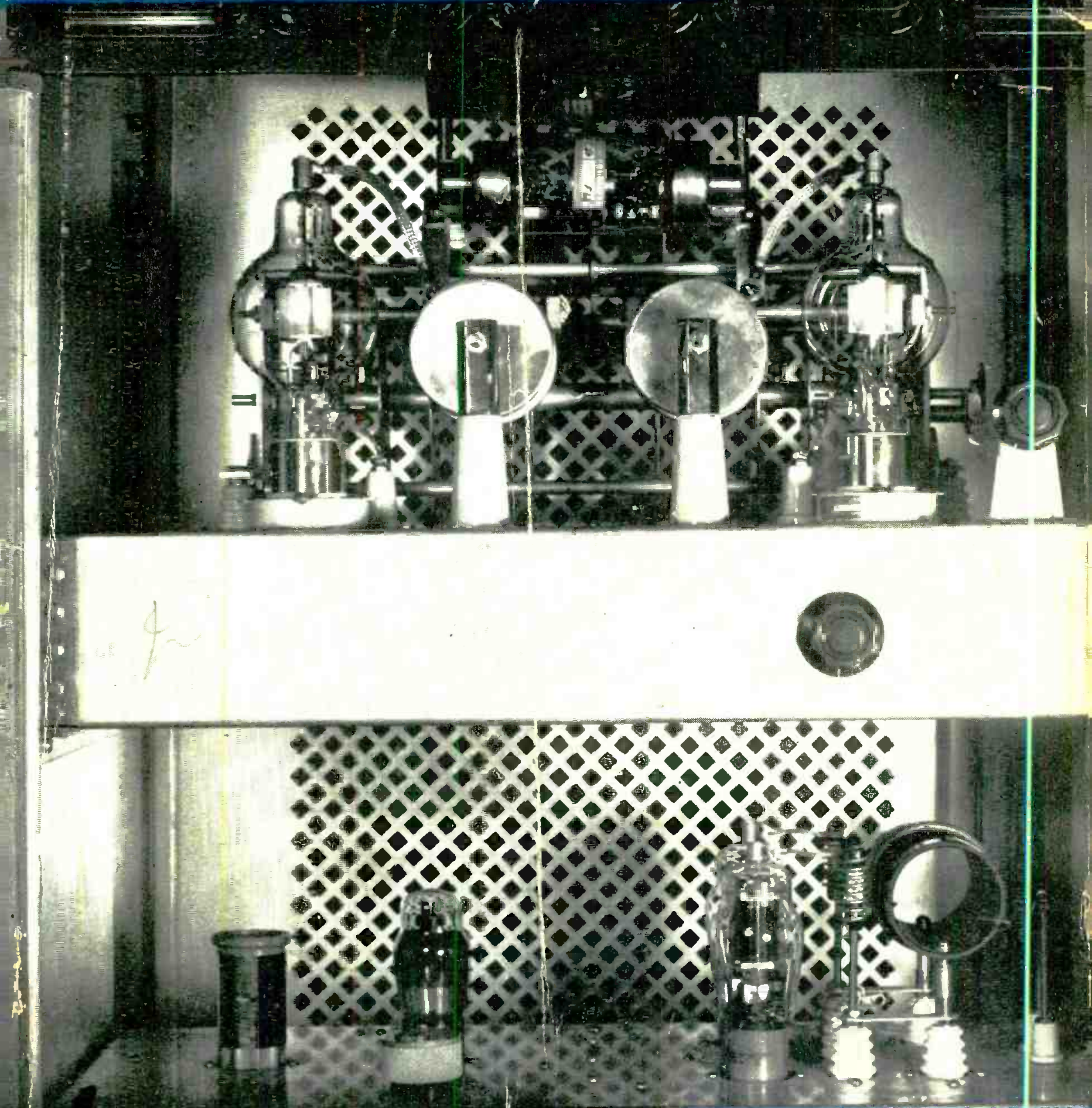
RADIO

ESTABLISHED 1917 — N 256



THIS MONTH

- AURORA ULTRA HIGH PROPAGATION
- PRACTICAL PEAKED AUDIO AMPLIFIER
- A.C.-D.C. VACUUM-TUBE VOLTMETER
- FLEXIBLE [illegible]-WATT EXCITER - - - XMTR

Technical Radio and Electronics

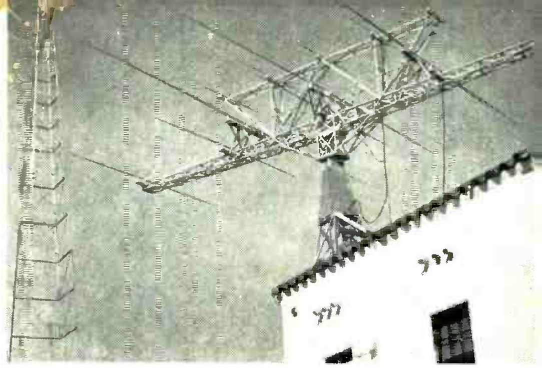
February 1941

NUMBER 256

30c IN U.S.A.

Leading Amateurs Endorse BUD Parts

READ THIS CONVINCING LETTER FROM W4EDD



WEDD LABORATORIES
P.O. Box 4550 • Coral Gables, Florida

Mr. Max L. Haas
Bud Radio, Inc.
Cleveland, Ohio

Dear Max:

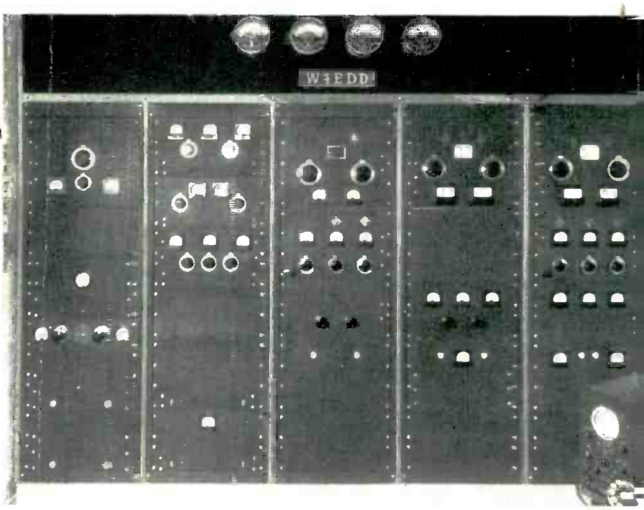
Complying with your request, I am sending photographs of my rigs.

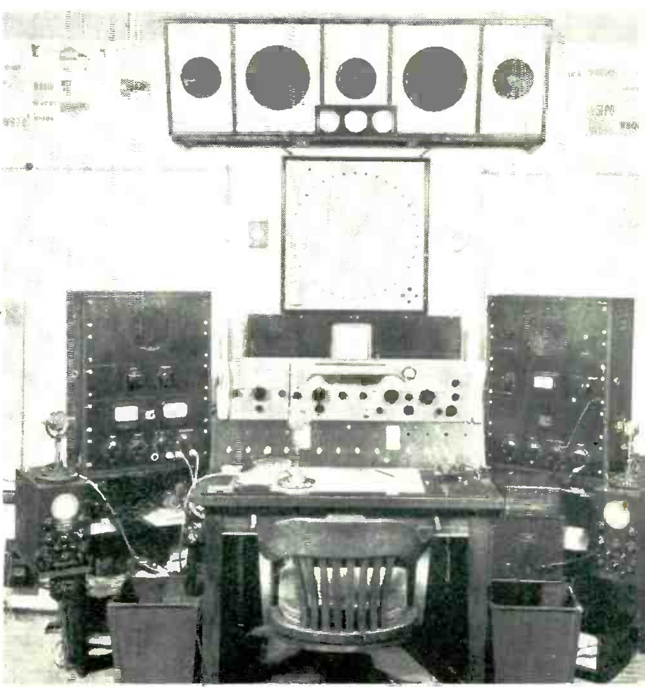
Three or four times I have tried to write a letter that expresses my high opinion of BUD parts -- but each time my enthusiasm has run away with me. I think the signal put out by W4EDD is the best testimonial I can give you on the performance of your products.

As you know, there are five transmitters here, covering from $2\frac{1}{2}$ meters to 160 meters. The input used is 1000 watts on all bands except $2\frac{1}{2}$ meters, where 500 watts is used. When I designed these transmitters, I used components whose past performance had convinced me of their superiority. That's why BUD coils, condensers, cabinets, etc. are used throughout. I know that their use has added tremendously to my personal enjoyment of ham radio.

Best of 73's.

Robbie
W4EDD





Here's a letter that certainly speaks for itself! This well known amateur, familiar to many of you as W4EDD, gives BUD products a large share of the credit for his enjoyment of radio and for his success as a ham. His complete, up-to-date BUD-equipped rigs (shown in the photos) are admired by all who see them.

Join the ranks of enthusiastic BUD customers! Your jobber can supply you.

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MISCELLANEOUS FEATURES

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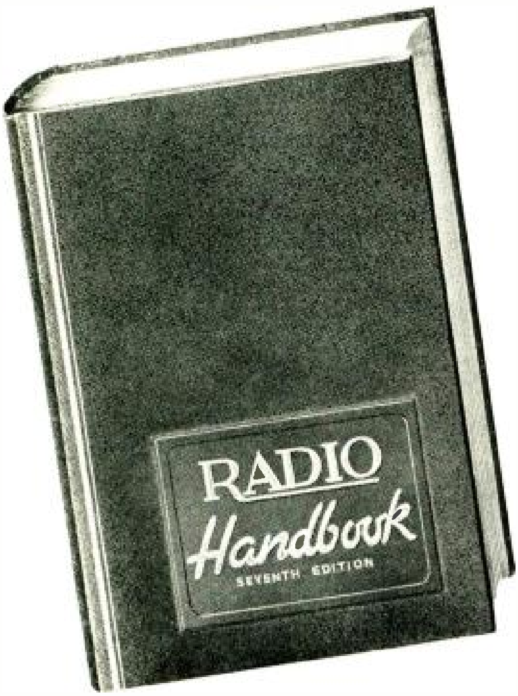
SEVENTH ANNUAL EDITION TEXT OF PRACTICAL

The Editors of RADIO have unquestionably become in recent years the outstanding group in radio not affiliated with a definite commercial interest. They are all practical radio engineers and active amateurs of many years' experience. They are the source of the reputation and prestige of RADIO, envied by publications of larger circulation.



Starting several years ago with an extensive set of "notes" compiled for their own use, The Editors of RADIO have developed the present "Radio" Handbook, which is now in its seventh edition. Each edition is thoroughly revised, not merely brought up to date. To keep up with rapid developments in commercial equipment, the great majority of items shown in the constructional pages are newly built for each edition. Though a few outstanding items were selected from other publications by the same publisher, the greatest portion are built especially for this handbook. All have been tried in actual practice.

Taken all in all, no effort has been spared in an attempt to compile the most comprehensive book on the subject, both as a reference for those with wide knowledge of the field and as a practical text for those of limited knowledge and means.

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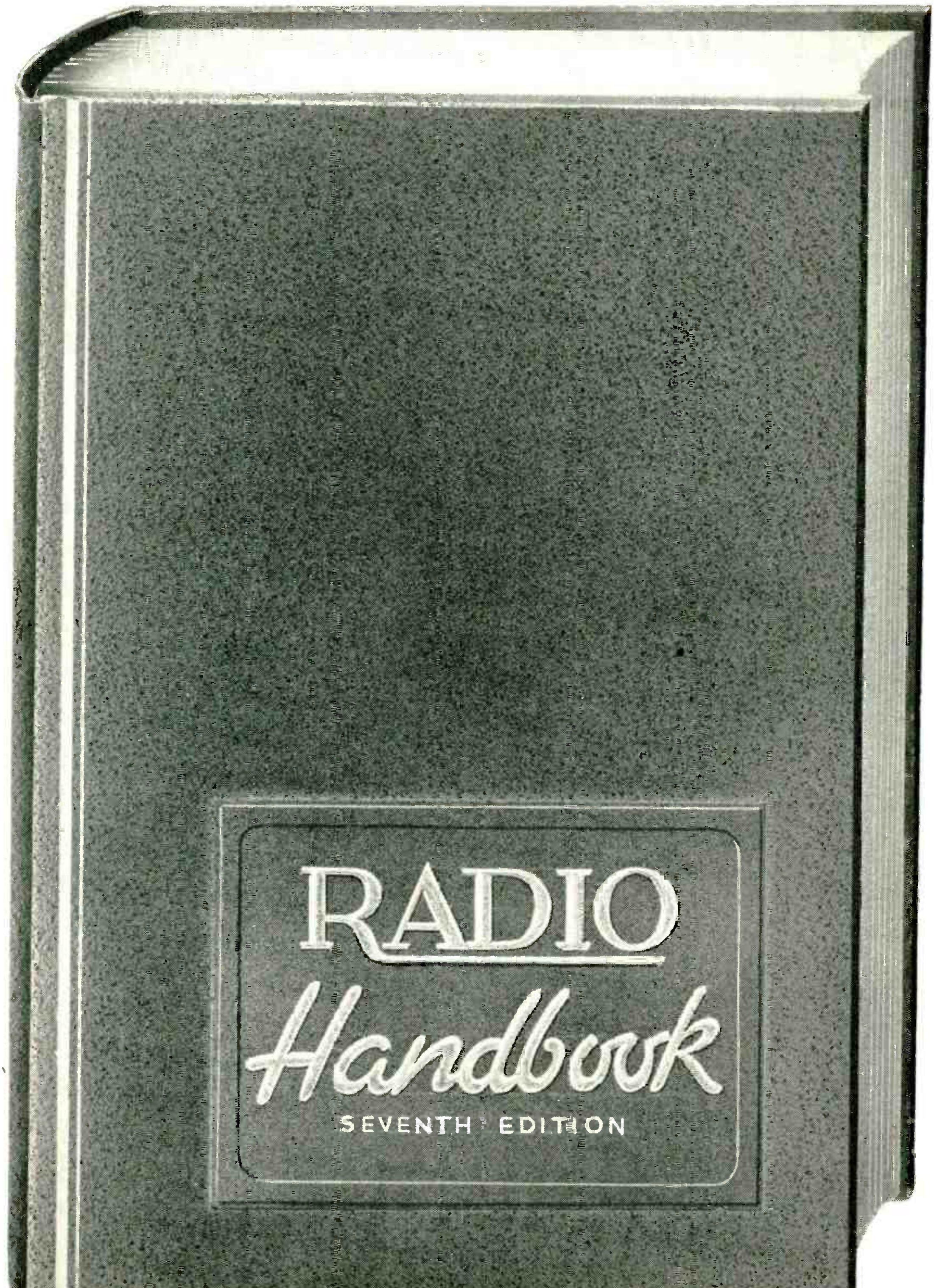

RADIO
Handbook
SEVENTH EDITION

Past • Present and • Prophetic

Delayed Action

Editor Dawley has been promising to build himself a new transmitter for years, but it is only lately that he has been able to finally decide on the proper exciter—you'll find it on page 16. Placing the exciter in use has been delayed by a series of accidents to the 35TG's. Dawley pulled the base off first one and someone sat on the second, thus exhausting our present supply of this particular type.

Coil Dope

Recently the number of letters inquiring about the design of tapped-coil bandspread systems has reached serious proportions, making it necessary to take some action on the matter. Associate Editor Norton sharpened up a dozen pencils, acquired a supply of scratch paper and proceeded to delve into the subject, with the result that next month will see a set of charts showing where to put that tap. He says that if time permits he will throw in a "once over lightly" on other bandspread systems, as well.

From the Mailbag

Many letters arrive inquiring for "blueprints and complete data" on equipment shown in RADIO and the HANDBOOK. Now we are always glad to give as much additional information as possible concerning a particular part or section of a circuit which you think was insufficiently described, but we do not have "blueprints" or complete lists of materials available. We honestly try to give all pertinent information in the original article, without telling where each wire and screw is located. Again, we will be glad to elucidate on particular parts or circuits which seem to need further description, but—blueprints—we just don't have any.

Audio Selectivity

Of late the unearthly screeches, grunts and groans issuing from the lab have been somewhat of a trial to everyone of the staff except Editor Smith, their perpetrator, who seems to revel in odd noises. Which is one way of introducing the peaked audio filter shown on page 23. We'll have to admit that this thing is quite a gadget, in spite of the noise it took to perfect it. A receiver of unusual design built around this type of amplifier is now being constructed.

Some of Smith's noise has been of the vocal variety in connection with the testing of a new compressing speech amplifier. The amplifier is scheduled for description next month. It has some new tricks to eliminate that distressing hush-hush sound so often associated with audio compression equipment.

QTH?

Will the **George W. Banks** who ordered a RADIO Handbook sent as a gift to a friend please send either his or the friend's address?

Propagation Propaganda

Perry Ferrell is with us again, on page 20, with "Aurora U.H.F. Propagation." This "Wil o' the Wisp," the Aurora, is being stripped of its ectoplasmic nightshirt for all to judge and adapt to their particular needs. Mr. Ferrell does a quite respectable job in this connection.

The Forgotten Feeder

Yep, forgotten—that's what they are. Once a set of feeders have been installed and—if necessary—adjusted, they're usually left to themselves unless calamity strikes from without. When, as is often the case, feeders are brought into the shack in a rush to get on the air, we mutter a solemn vow to "fix 'em up later" . . . which, alas, never sees fulfillment.

"Fun With Feeders" or, "Now I Have a Happy Home" might well be subtitles for the article by W. E. McNatt on page 27. If you have landlord or x.y.l. troubles because of unsightly feeders, the suggestions in this article may help you restore amicable relations.

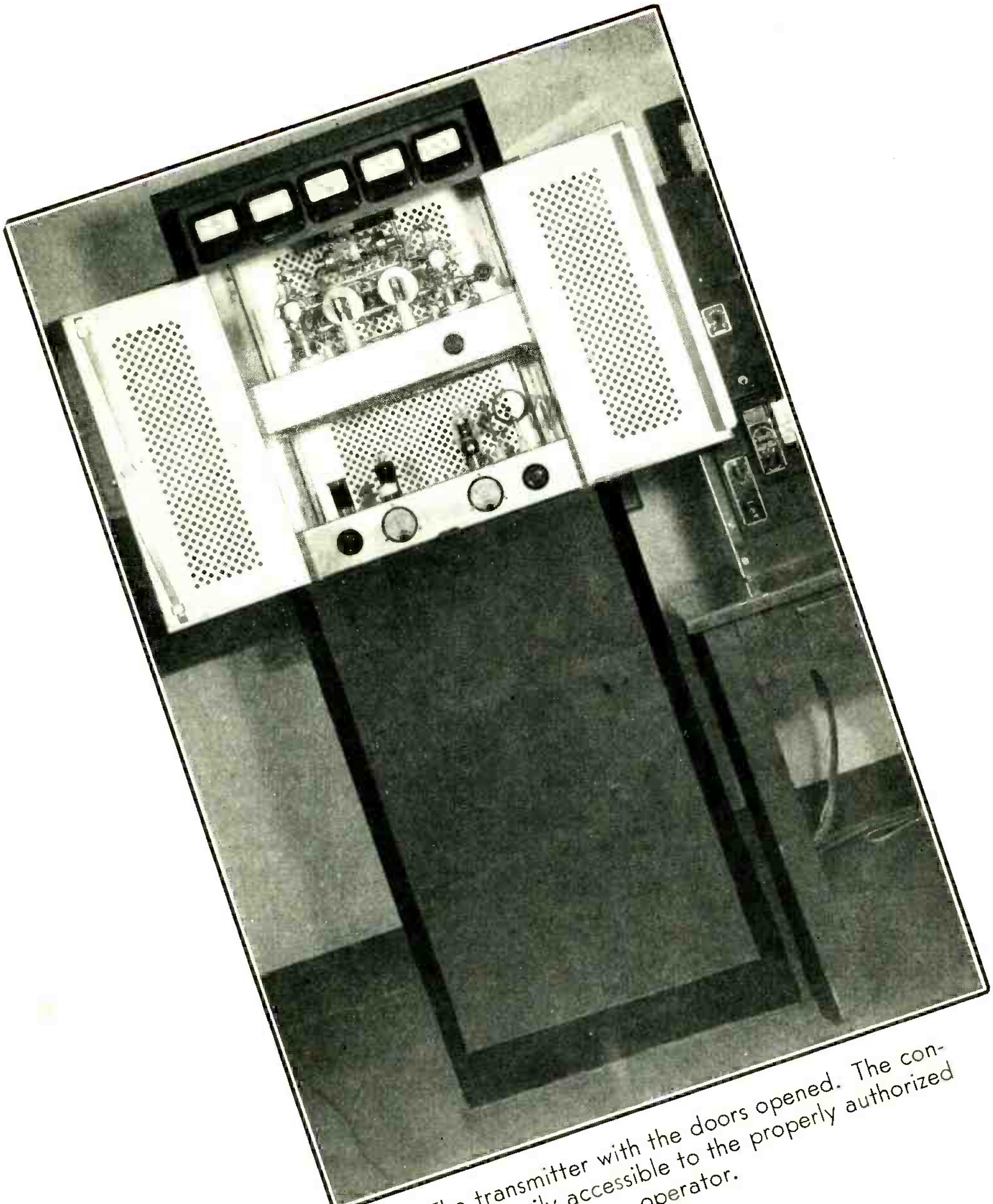
V. T. Voltmeters

When you improve some piece of equipment in your shack, you like to tell your friends about it, don't you? Well, so do we—and consequently you are invited to turn to page 32 and see our current preference in vacuum-tube voltmeters. Yessir, mighty useful little job after having tussled with less flexible ones. Inexpensive, too!

Ah, Spring!

We could quote the old wheeze about Spring and a young man's fancy . . . instead,

[*Continued on Page 86*]



● The transmitter with the doors opened. The controls are easily accessible to the properly authorized operator.

A 500-Watt COMMERCIAL TRANSMITTER

By GEORGE F. MOYNAHAN, Jr.,* W6AXT

Last month there was shown a police or commercial transmitter designed for one kilowatt output. Herein is described a transmitter for similar service and having a rated power output of 500 watts.

After having built a number of commercial radiotelephone transmitters ranging in power output from 50 to 5000 watts and having had an opportunity to observe these transmitters over a period of years, the transmitter described herein was built as an approach to an ideal in the compromise between low cost and high performance. Essentially there is no startling new development in this equipment, but rather it represents an attempt to design a simple, highly stable transmitter of high performance, of low first cost, and requiring little maintenance.

The resulting piece of equipment can be built for less than fifty cents per watt input (exclusive of labor) and is easily the equal of commercial equipment costing several times this amount. This cost includes everything from microphone to final modulator tubes and from crystal to the antenna output circuit.

General Design

The transmitter is mounted in a special rack similar to the conventional enclosed type, but designed to accommodate 24-inch panels instead of the usual 19-inch type. The additional 5 inches of width is highly desirable for a transmitter of this power as it allows room for some freedom of design and placement of parts. The three solid panels as shown in the photograph are each 12¼ inches high and support the audio and power units.

The bottom shelf supports the main power supply. The shelf above this supports the modulator tubes and transformer as well as the control and overload relays. The third of these solid panels holds the shelf on which is mounted the low voltage power supply and two audio stages.

The radio frequency stages are mounted on the usual type of inverted boxes or chassis, and are hung in the cabinet on angle pieces in a manner to permit their easy removal and change. Instead of using a panel, these are protected by punched grill-work doors which provide ready access to all r.f. components. Above these doors is placed a meter strip 5¼ inches high which supports all meters for the final stage and modulator. It will be noted that the equipment was running nearly 900 watts input when the cover photograph was taken.

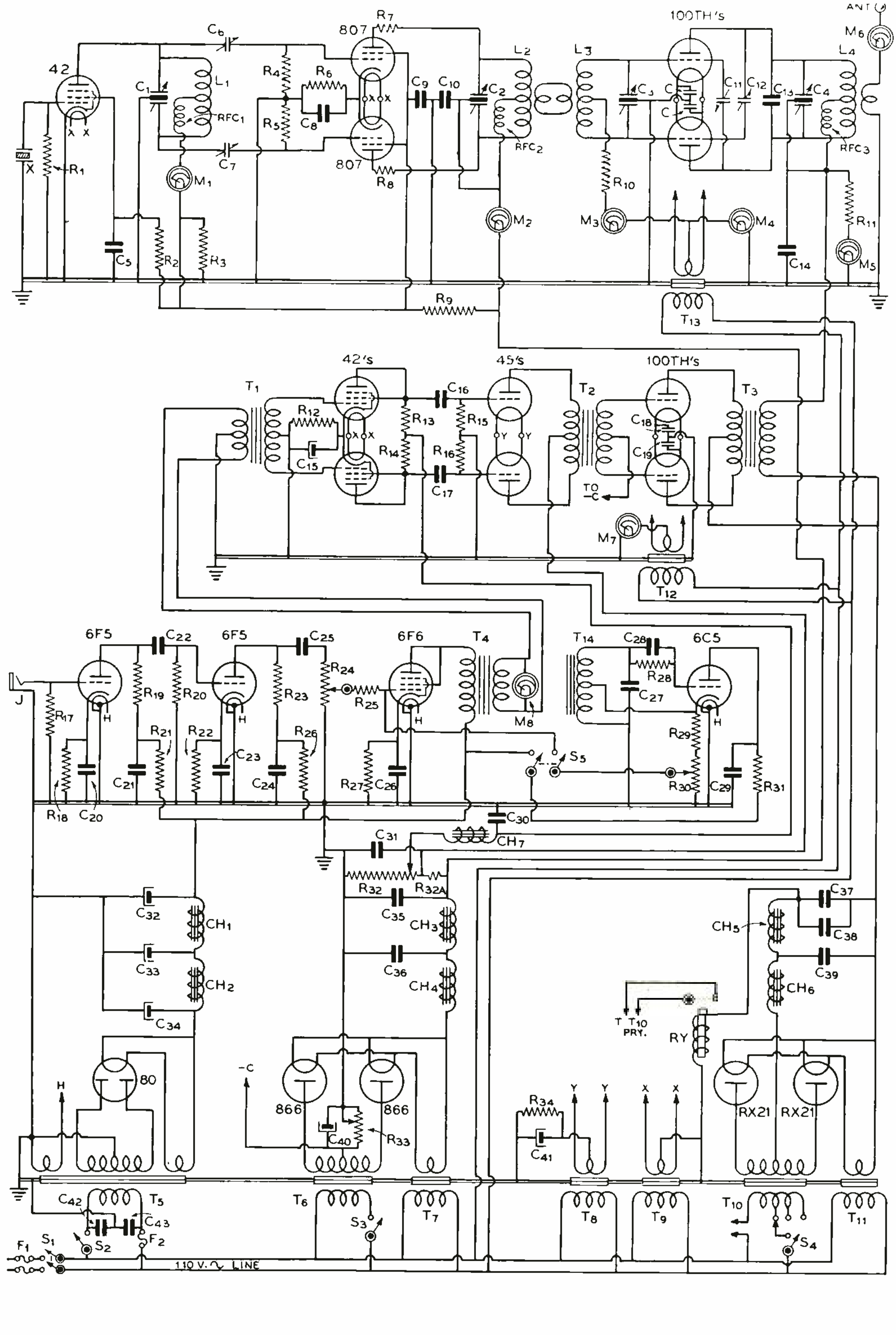
The Main Power Supply

The high voltage power supply for the modulator and final r.f. stage consists essentially of a specially built 1½ kva 500 v.c.t. transformer, two Eimac type RX-21 rectifier tubes and a choke input filter as shown in the diagram of figure 1. This power supply deviates from ordinary practice in two respects. First, the filter chokes are in the negative lead, making very high voltage insulation unnecessary and practically eliminating any danger of insulation breakdown. Second, the transformer is specially wound with primary taps that permit variation of the output voltage in three steps. This is very convenient for tuning or for operating at reduced power.

Still another feature of the power supply is the use of two General Electric auxiliary motor contactors instead of the usual radio

*Capt. Signal Corps U.S.A., Fort Ord, California.

WIRING DIAGRAM OF THE TRANSMITTER



VALUES OF COMPONENTS

C_1—100-µµfd. per section midget
C_2—100-µµfd. per section, .075" spacing
C_3—100-µµfd. per section, .125" spacing
C_4—50-µµfd. per section, .500" spacing
C_5—.01-µfd. mica
C_6, C_7—50-µµfd. midget variable
C_8, C_9, C_{10}—.01-µfd. mica
C_{11}, C_{12}—Neut. condensers, see drawing
C_{13}—Fixed vacuum condenser, 50-µµfd.
C_{14}—.001-µfd., 12,500-volt mica
C_{15}—50-µfd. 50-volt electrolytic
C_{16}, C_{17}—.01-µfd. 600-volt tubular
C_{18}, C_{19}—0.5-µfd. 400-volt tubular
C_{20}, C_{21}—0.5-µfd. 400-volt tubular
C_{22}—.01-µfd. 400-volt tubular
C_{23}, C_{24}—0.5-µfd. 400-volt tubular
C_{25}—.01-µfd. 400-volt tubular
C_{26}—0.5-µfd. 400-volt tubular
C_{27}—.04-µfd. 400-volt tubular
C_{28}—.01-µfd. 400-volt tubular
C_{29}—0.1-µfd. 400-volt tubular
C_{30}, C_{31}—2-µfd., 600-volts
C_{32}, C_{33}, C_{34}—8-µfd. 450-volt electrolytic
C_{35}, C_{36}—2-µfd., 1000 volts
C_{37}, C_{38}, C_{39}—2-µfd., 3000 volts
C_{40} — 40-µfd., 250-volt electrolytic
C_{41} — 25-µfd., 100-volt electrolytic
C_{42}, C_{43}—.01-µfd. 600-volt tubular
R_1—50,000 ohms, 1 watt
R_2—30,000 ohms, 10 watts
R_3—8000 ohms, 20 watts
R_4, R_5—25000 ohms, 2 watts
R_6—200 ohms, 10 watts
R_7, R_8—Parasitic supressor
R_9—5000 ohms, 50 watts
R_{10}—2500 ohms, 100 watts
R_{11}—400,000 ohms, 80 watts (4 100,000-ohm, 20-watt resistors in series)
R_{12}—325 ohms, 10 watts
R_{13}, R_{14}—25,000 ohms, 10 watts
R_{15}, R_{16}—250,000 ohms, 1 watt
R_{17}—1 megohm, 1/2 watt
R_{18}—2250 ohms, 1/2 watt
R_{19}—250,000 ohms, 1/2 watt
R_{20}—500,000 ohms, 1/2 watt
R_{21}—100,000 ohms, 1/2 watt
R_{22}—2250 ohms, 1/2 watt
R_{23}—250,000 ohms, 1/2 watt
R_{24}—250,000-ohm potentiometer
R_{25}—70,000 ohms, 1/2 watt
R_{26}—100,000 ohms, 1/2 watt
R_{27}—750 ohms, 10 watts
R_{28}—50,000 ohms, 1/2 watt
R_{29}—50,000 ohms, 1 watt
R_{30}—25,000-ohm potentiometer
R_{31}—50,000 ohms, 1 watt
R_{32}—20,000 ohms, 50 watts
R_{32A}—1500 ohms, 100 watts
R_{33}—250 ohms. 50 watts
R_{34}—1500 ohms, 20 watts
T_1—Line to p.p. grid trans.
T_2—Var. ratio driver trans., 18 watt rating
T_3—400-watt modulation trans.
T_4—Triode plate to 500-ohm line trans.
T_5—700 v. c.t., 145 ma.; 5 v., 3 a.; 6.3 v., 4.5 a.
T_6—2000 v. c.t., 300 ma.
T_7—2.5 v., 10 a.
T_8—2.5 v. c.t., 5.25 a.
T_9—6.3 v. c.t., 2.5 a.
T_{10}—6000 v. c.t., 1500 watts
T_{11}—2.5 v., 20 a.
T_{12}, T_{13}—5 v. c.t., 16 a.
T_{14}—Secondary of p.p. input trans.
RFC_1—2.5 mhy., 125 ma.
RFC_2—2.5 mhy., 500 ma.
RFC_3—2.8 mhy., 1000 ma.
CH_1, CH_2—20 hy., 50 ma.
CH_3—10 hy., 300 ma.
CH_4—6-19 hy., swining, 300 ma.
CH_5—12 hy., 500 ma.
CH_6—6-19 hy., swinging, 500 ma.
CH_7—20 hy., 50 ma.
M_1—0-50 ma.
M_2—0-500 ma.
M_3—0-250 ma.
M_4—0-750 ma.
M_5—0-10 ma. (serves as 0-4000 voltmeter)
M_6—0-5 a., r.f.
M_7—0-750 ma.
M_8—Volume indicator
L_1, L_2, L_3, L_4—Coils suitable for frequency of operation

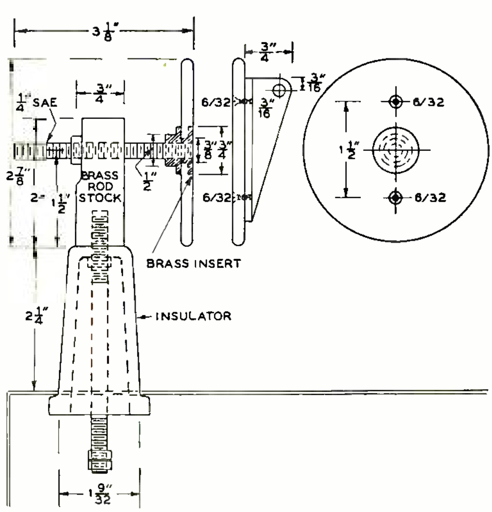
type of relay. These are not very expensive and the use of a separate relay in each leg of the circuit is a safety precaution taken after the occasional failure to open of some relays used in the past. This use of dual relays makes failure nearly impossible and is highly desirable if remote operation is contemplated. The overload relay is considered a luxury by many amateurs, but it is one piece of equipment which will really pay for itself many times through protection of more expensive equipment.

The Modulator

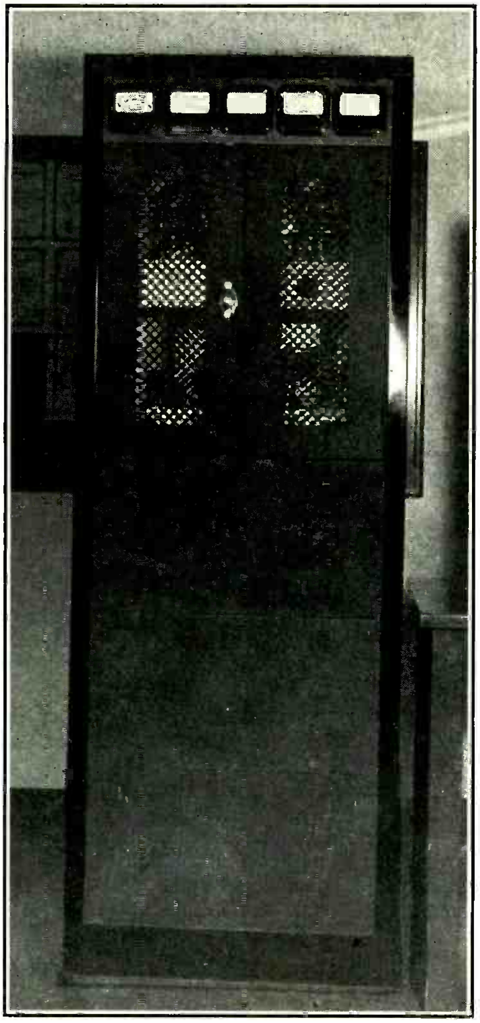
The modulator stage is entirely orthodox and conventional. The transformer is specially built to provide better than ordinary insulation. The tubes used are a pair of Eimac 100TH's and they are capable of modulating any lawful power input in an amateur rig. The filament transformer for the modulator tubes is mounted near them on the same chassis to prevent excessive voltage drop in the secondary leads.

The Low Voltage Power Supply and Audio Amplifier

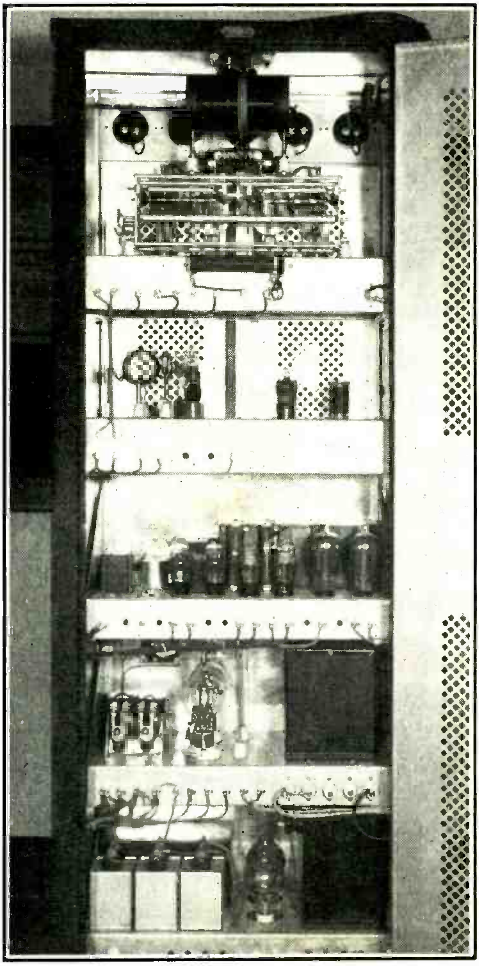
The deck immediately above the modulator stage supports components of the low voltage power supply and audio driver stages.



Detail drawing of the construction of the built-in neutralizing condensers.



Front view of the transmitter with the doors closed. There are no exposed controls which might invite unauthorized "adjustment."

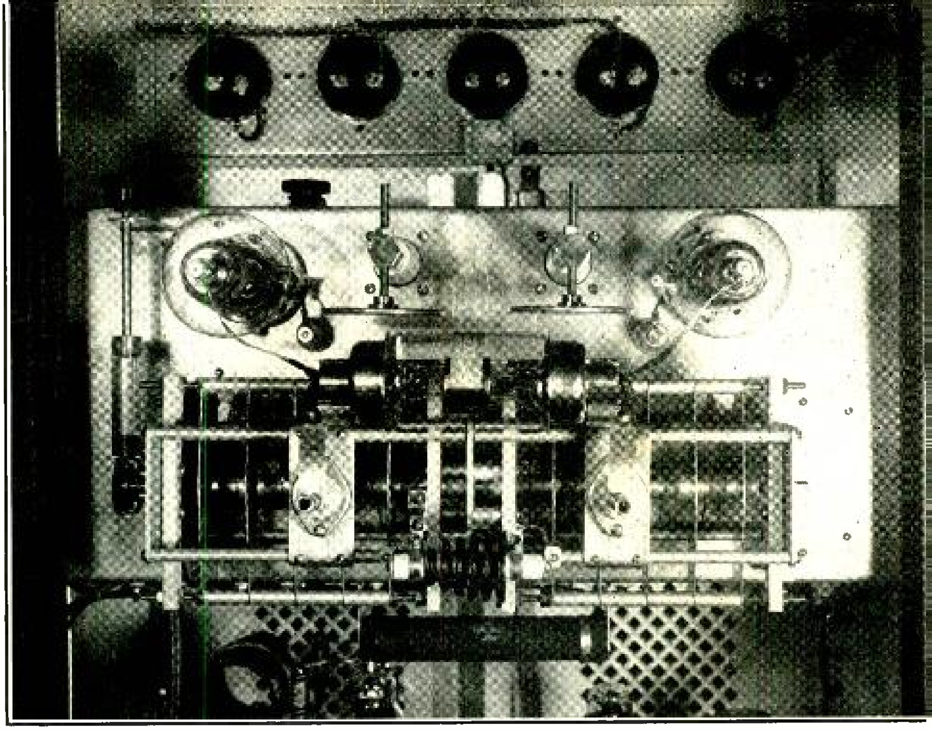


Rear view of the transmitter with the doors opened. Power supplies occupy the lower decks, the modulator and control relays are on the second shelf, with the speech equipment and a low-voltage power supply on the third shelf.

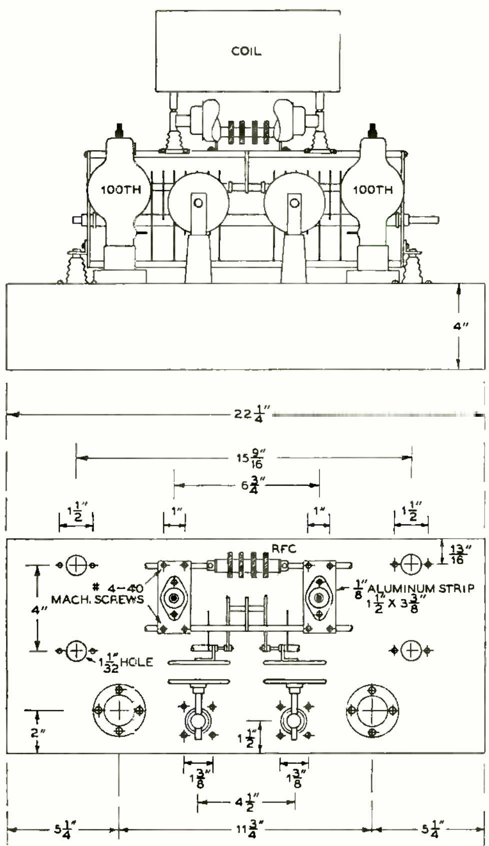
The power supply part of this section consists of a standard Kenyon transformer, 1000-0-1000 volts, a pair of 866 rectifier tubes and the usual choke input filter. Bias for the modulator tubes is provided by a dropping resistor in the negative lead of this supply.

The audio system consists of a tube to push-pull grid transformer working into a pair of 42's operating as triodes resistance coupled to a pair of 45's. The latter tubes are self-biased using a resistance of 1500 ohms and with an applied plate potential of 600 volts. This is higher than the recommended value for these tubes, but one set has been in daily use for two years and shows no signs of deterioration. The principal point is to keep the plate dissipation down to a value where the tubes show very little color. Operating these tubes with this high voltage, their output is ample to drive the 100TH modulators.

Placing this comparatively low gain, medium power audio system in the transmitter is convenient in that it eliminates the necessity of running audio around the operating room at high level, and permits operation of the transmitter with an audio input of the



Looking down upon the final amplifier stage with its plate coil removed. In this photograph the amplifier itself has been removed and turned upon edge on the shelf brackets.



Schematic layout diagram of the final amplifier stage, indicating placement of the various components.

order of 2 db (below 6 milliwatts) for full modulation.

The Radio Frequency Oscillator and Buffer Unit

This particular part of the transmitter is not entirely suitable for amateur use, unless it is desired to work only in the lower frequency bands. Its principal difficulty in this respect is that no provision is made for generation and amplification of harmonics of the crystal. As the unit stands, it consists of a type 42 used as a pentode crystal oscillator employing a split tank circuit to provide capacity coupled excitation to two type 807 tubes as a buffer amplifier.

The Final Stage

This unit is built around a convenient tank circuit using a Johnson 50-CD-130 condenser padded with an Eimac vacuum condenser. Neutralizing plates are built into the Johnson condenser as shown in the photographs and sketches. The final tank condenser is mounted with its shaft parallel to the long side of the chassis and is driven by a small preloaded worm gear of the automobile receiver type.

[*Continued on Page 73*]

Versatility in A 100-Watt

TRIODE TRANSMITTER-EXCITER

By RAY L. DAWLEY,* W6DHG

For the past several years, ever since the introduction of transmitting beam tetrodes, it has seemed that every medium powered exciter-transmitter which has been published has had one of these transmitting beam tubes in the output stage. While such tubes do have their share of advantages for use in such arrangements, it has seemed that the chief advantages have been: (1) no neutralization is required, and (2) the excitation requirements are very low.

After having designed several of these beam-tube-output transmitters, always considering the above two advantages, subsequent operation of the rigs, with normal tube replacements, has indicated that perhaps these advantages can be outweighed by other considerations involving the relatively high cost of these tubes. In the first place, the beam tubes do have very low excitation requirements—but is this extremely low requirement of any great advantage? Most designers would use a 6L6 to excite the tube anyway, and a 6L6 is easily capable of 20 watts output as a doubler, or even as a quadrupler. So why not use the 6L6 to excite a triode? As for neutralization, with a good low-capacity triode in the output stage, the neutralization can be set on 28 Mc. and it will hold over all the amateur bands without readjustment. It was with these thoughts in mind that the exciter-transmitter shown in the accompanying photographs and diagram was designed and constructed.

Design of the Unit

In the design of this exciter an attempt was made to incorporate as much flexibility as possible. Hence, provision was made for v.f.o. input on 160, 80, and 40, and the unit is also laid out so that a crystal on any of these three bands may be used. As for output, the 35TG stage is capable of more than 100 watts output as an amplifier on all bands from 160 through 10. In addition, the final 35TG stage may be run as a doubler to 56 Mc. with 60 to 70 watts of useful power output. Blocked grid keying of the 35TG has proved to be an excellent keying method.

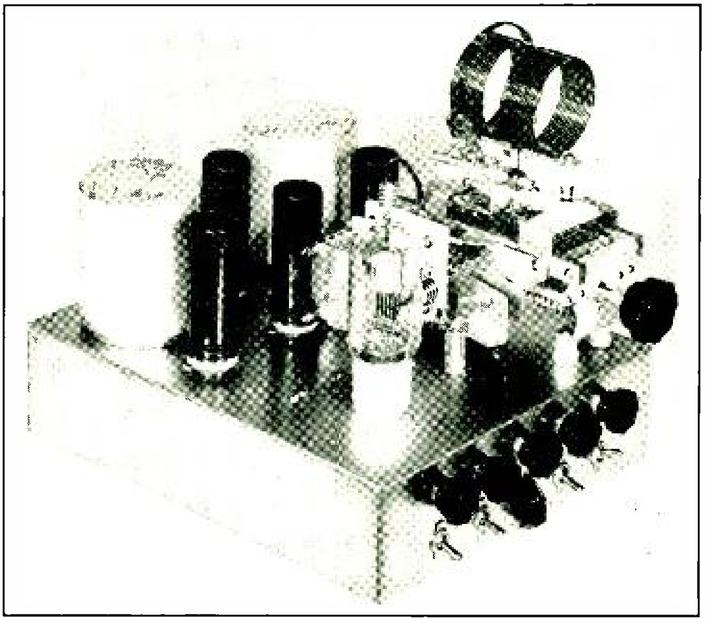
Circuit Lineup

Five tubes are used in the exciter-transmitter. They are: a 6L6 in the first stage which can act as a crystal oscillator with crystals on any of the three previously mentioned bands, or it can act as a doubler with 160- or 80-meter r.f. input from the v.f.o. The second stage is another 6L6 which can act either as an oscillator with 80- or 40-meter crystals, or it can act as a doubler to 80 or 40 with v.f.o. input on the next higher band. The next 6L6 acts as a doubler or quadrupler to 20 meters with excitation from the first 6L6 stage, and the last 6L6 acts always as a doubler to 10 meters with excitation from the 20-meter stage. The final stage is a 35TG, to which excitation is delivered through a selector switch from any of the four preceding 6L6 stages by capacity coupling.

Each of the 6L6 oscillator or doubler stages has a switch in its cathode circuit to remove its drain from the plate supply when this stage is not in use. Individual switches have been used, rather than a switch ganged to S_5 which selects the tube which is to excite the 35TG, so that greater flexibility in the operation of the exciter may be obtained.

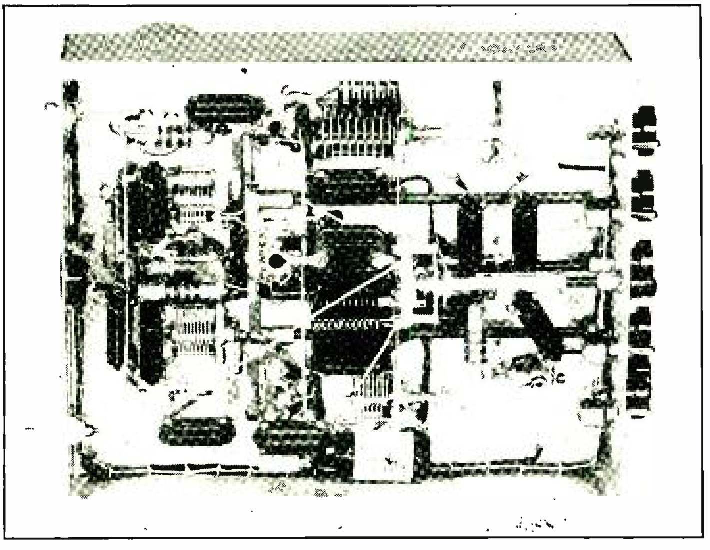
All the exciter stages run from one common power supply which can have an output voltage from 350 to 550 volts. However, with 400 volts applied to the exciter portion, ample excitation to the 35TG is obtained on all bands. Hence, this is the recommended value of plate voltage. No metering provision has been provided for the tubes in the exciter since it is impossible for them to draw excessive plate current at the values of cathode

*Editor, RADIO.



PARTS LAYOUT OF 100-WATT EXCITER

The unit is designed for use with a front panel, which was omitted in this picture to give a better view of the components above the chassis. Observe particularly the plug-in air condenser (used on low frequencies) and the home made neutralizing condenser.



UNDER CHASSIS VIEW OF 100-WATT EXCITER

This compact arrangement permits short leads, especially important on 10 and 20 meters when bandswitching is employed in the grid of the capacitively coupled final stage. The input is at the upper left, the frequency of each stage getting progressively higher as it follows the 6L6 doublers down the rear of the chassis, over to the right and up. The 10 meter tank may be seen in the upper center of this view, and to the right of this tank the socket for the 35-TG.

bias and screen voltage used. These stages are tuned merely for maximum grid current on the 35TG stage.

The First 6L6 Stage

Much of the flexibility of this exciter has been incorporated into the first stage of the unit. Both the grid and plate circuits of this stage come out to five-prong tube sockets. Either a crystal or an appropriate coil may be plugged into either of the two sockets. When either a crystal or a coil is inserted the proper connections are made to the element voltages, provided the connections are made to the sockets as indicated on the circuit diagram and the coils are strapped in the proper manner.

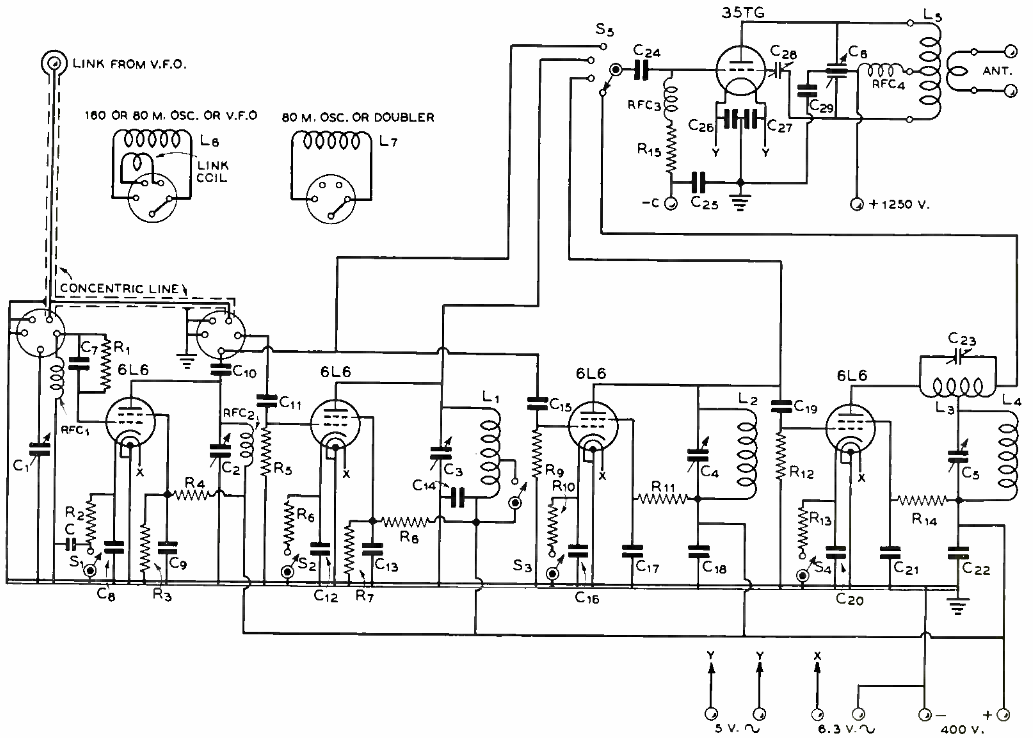


Figure 1.

SCHEMATIC DIAGRAM OF THE 100 WATT EXCITER.

C—.004 µfd. mica (C and R_2 placed close to tube cathode)
C_1—75 µµfd. midget variable
C_2—100 µµfd. midget variable
C_3, C_4—50 µµfd. midget variable
C_5—35 µµfd. double spaced midget
C_6—100 µµfd. per section, 3000 v. spacing. Shunted with plug-in fixed air condenser of 50 µµfd., 6000 v. spacing, for 1.7 and 3.5 Mc.
C_7 to C_{14}—.006 µfd., 1000 v. mica
C_{15}—40 µµfd., 1000 v. mica
C_{16}, C_{17}, C_{18}—.006 µfd., 1000 v. mica
C_{19}—.0001 µfd., 1000 v. mica
C_{20}, C_{21}, C_{22} — .006 µfd., 1000 v. mica
C_{23} — 3-30 µµfd. mica trimmer
C_{24}—.0001 µfd., 1000 v. mica
C_{25}, C_{26}, C_{27} — .006 µfd., 1000 v. mica
C_{28}—Homemade neutralizing condenser; see text.
C_{29}—.002 µfd., 5000 v. mica
R_1—100,000 ohms, 2 watts
R_2—500 ohms, 10 watts
R_3, R_4—50,000 ohms, 2 watts
R_5—100,000 ohms, 2 watts
R_6—500 ohms, 10 watts
R_7, R_8—50,000 ohms, 2 watts
R_9—100,000 ohms, 2 watts
R_{10}—500 ohms, 10 watts
R_{11}—50,000 ohms, 2 watts
R_{12}—100,000 ohms, 2 watts
R_{13}—500 ohms, 10 watts
R_{14}—500,000 ohms, 2 watts
R_{15}—2500 ohms, 10 watts
$RFC_{1, 2, 3, 4}$—2.5 mh. 125 ma. r.f. chokes
$S_{1, 2, 3, 4}$—S.p.s.t. toggle switches
S_5—Single pole 4 throw ceramic switch

If a 160- or 80-meter v.f.o. is to be run into the grid circuit of the stage, a coil such as is shown in the circuit diagram as L_6 should be used. A coil wound as L_6 may also be used in the *plate* circuit of the first 6L6 when an 80- or 160-meter crystal is being used in the grid circuit. However, when an 80- or 160-meter v.f.o. is being fed into the grid circuit of this tube, a coil that does not have a link wound on it must be used in the plate circuit. This is obvious since if both the plate and grid circuit coils had links wound on them, there would be a great deal of undesired coupling between the plate and grid circuits through the common link.

The V.F.O. Input Circuit

The energy from the v.f.o. unit can be fed from the operating table to the grid circuit of the exciter by means of a low-impedance line of the concentric type. A watt or two of excitation power will be ample for exciting the 6L6 from the v.f.o. line. Also, it will be noticed by reference to the circuit diagram, the energy from the v.f.o. may be fed into the coil in the plate circuit of the first 6L6. This in turn, with the cathode switch opened on the first 6L6, feeds the v.f.o. energy directly to the grid of the second 6L6, or if the switch S_5 is in the proper position, to the grid circuit of the 35TG. Hence we see that v.f.o. energy on any band may be fed to the grid of the 35TG if a coil for this band is inserted in the second coil socket, or this v.f.o. energy may be fed to either of the first two stages of the exciter.

The Second 6L6 Stage

It will be noticed that the second 6L6 stage has a fixed coil in its plate circuit, but that this coil is tapped and has a switch to short out the tapped portion. This is done so that the plate circuit of this stage may be tuned either to the 80- or 40-meter bands. Its plate circuit is tuned to 40 meters for operation on 40 with an 80-meter crystal, and the plate circuit is tuned to 80 for operation on this band with a 160-meter crystal. If desired, this stage may also be used as a crystal oscillator on the 80- and 40-meter bands when it is desired only to excite the 35TG stage. It is only necessary to open all the cathode switches except the one for the second 6L6, insert the crystal into the second coil socket, and switch the excitation of the 35TG to the second position.

The 14- and 28-Mc. Stages

The third and fourth 6L6 stages have fixed coils in their plate circuits which are tuned to 14 and 28 Mc. respectively. The first 6L6 operates as a quadrupler from the output of the *first* stage of the exciter. This stage is operated as a quadrupler rather than as a doubler since it gives equally as good output and eliminates the additional drain of an intermediate doubler stage. It can, of course, be operated as a doubler when a 40-meter crystal is being used in the first stage, or when the first stage is doubling to 40 from an 80-meter v.f.o.

The 14-Mc. 6L6 doubler is capacity coupled to the grid of the 28-Mc. stage. The plate circuit of the 28-Mc. doubler is rather unique in that it has a small circuit tuned to the third harmonic connected between the plate of the tube and the 28-Mc. tank circuit. It is connected so that the energy coupled from the plate of this tube to the 35TG grid has a semi-peaked waveform resulting from the addition of the out-of-phase third-harmonic energy to the fundamental component. This peaked excitation waveform results in greatly

COIL SPECIFICATIONS

L_1—80-40 meter doubler coil: 38 turns no. 24 d.c.c., 1" dia., 1¼" long, tapped 20 turns from the ground end.

L_2—20-meter doubler coil: 11 turns no 14 enam., 1¼" dia., 1¼" long.

L_3—10-meter doubler coil: 5 turns no 14 enam., 1¼" dia., 1¼" long.

L_4—85-Mc. third-harmonic coil: 7 turns no. 14 enam., ½" dia., ⅝" long, tapped at center.

L_5—Final stage plate tank coil: Manufactured 150-watt plug-in coils.

L_6—160-meter osc. or v.f.o. coil: 42 turns no. 24 d.c.c., 1½" dia., 1¼" long. Link coil is 6 turns no. 24 d.c.c. below the other coil.

L_7—80-meter doubler or osc. coil: 23 turns no. 20 d.c.c., 1½" dia., ¾" long. If coil is to be used with v.f.o., wind 4 turn link at bottom of v.f.o. coil.

improved efficiency of the 35TG stage when it is operating as a doubler from 28 to 56 Mc. The efficiency of the 35TG is also theoretically increased a very slight amount when it is operating straight through on 28 Mc. with the sharply peaked excitation waveform. In tuning up this harmonic tank circuit, first tune the 28-Mc. circuit to resonance, then with a dial-lamp pickup loop and a roughly calibrated wavemeter simply peak the small circuit to greatest brilliancy at the third harmonic of 28 Mc. or about 85 Mc. This accessory circuit will then not have to be re-peaked for operation on any frequency in the 28-Mc. band.

The 35TG Final Amplifier

The final stage of the exciter-transmitter is a perfectly conventional capacity-coupled amplifier with split-stator plate neutralization. The plate tank condenser is a 100-$\mu\mu$fd. per section affair and this condenser alone is used to tune the 56, 28, 14, and 7 Mc. bands. For operation on the 1.7- and 3.5-Mc. bands an additional 50-$\mu\mu$fd. plug-in air condenser is connected across the two stators. This condenser was inadvertently omitted from the circuit diagram but can be seen in the top-view photograph. The jack base which supports the additional fixed air condenser is connected to brackets which attach directly to the stator lugs on the tuning condenser.

The neutralizing condenser for the 35TG is constructed from two small pieces of alum-

[*Continued on Page 82*]

AURORA U.H.F. PROPAGATION

By PERRY FERRELL, Jr.*

For the past two years amateurs using the u.h.f. bands (2½, 5 and 10 meters) have noted peculiarities in the reception of stations well into the area normally reached by extended ground wave. These stations have appeared out of the receiver background noise with garbled roars, r.a.c. modulation, or a high pitched hiss or rush superimposed on the carrier. This condition easily distinguished the signals from the more common propagation by bending of the u.h.f. waves in the lower troposphere, as in this case the signals would retain all their original clarity. This did not occur, however, without due ceremony, since such recognizable signals were almost invariably accompanied by bright aurora borealis displays and severe ionosphere and magnetic disturbances. Consequently, the name "aurora-dx" was coined and applied to these signals.

Aurora—What Is It?

The aurora itself generally appears as luminous delicate draperies consisting of straight-line streamers ending on the lower side in sharp, bright boundaries. This is what one should expect if we had streams of ionized material arriving from inter-stellar space along paths determined, almost entirely, by the earth's magnetic field. These streamers are forever in constant motion of their own, appearing to oscillate across the heavens and appear and disappear with equal abruptness.

Such streamers have been traced up to a height of 630 kilometres, which is the general location of the G layer, ionospherically speaking. However, some doubt as to the exactness of this measurement exists due to the rather inaccurate method of determining the height against the background of stars, or by forming a parallax through the use of two or more observers separated by short distances. The more brilliant lower boundaries are found generally within the region of 70 to 240 km., with particular emphasis on the 80-150 km. area. In this respect, the Canadian Polar Expedition of 1932-33 at Saskatoon found the normal lower boundary at 105 km. with the lowest ever observed (officially) at 60 km. and the extent of the streamers about 300 km. maximum. Their duplicate observation post recorded a mean average of 115.6 km. and the lowest boundary to be 72 km.[1]. Dr. Carl Stormer's observations in southern Norway, 1911-22 found a mean average of 110 km. and low of 80 km., which closely agrees with all other existent data[2].

These heights are very important to us, because the virtual height of the D layer (where probably an absorbing layer is formed during bursts of intense ultra-violet light from the sun, causing short-wave fadeouts) and the E layer (already "famous" for its sporadic activity) lie between 60 and 130 km.

It might be well to mention here that for a long time the exact components in the spectral photograph of aurora were unknown, since the outstanding line was one of 5,577.34 Angstrom Units, greenish-yellow in color and grouped among many lesser lines. However, it has since been deduced that the predominant gases in the auroral regions, which is just another way of saying as far as we're concerned in the ionosphere, are oxygen and nitrogen with a possible small admixture of helium. The bright spectral line results, according to some authorities, from the oxygen (ionized atomic form), or from the nitrogen-oxygen mixture, and some students still definitely state that it is due to a small amount of krypton.

Regardless, a faint auroral spectroscopic line can be found on spectrograms obtained on plates exposed to just the night sky, indicating that there is a permanent aurora in those regions, which naturally can be construed to mean that some electrifying action is taking place in the ionosphere at all times. Only during magnetic storms, or specifically the result of excessive bombardments of our upper at-

*107 East Bayview Ave., Pleasantville, N.J.

[1]*Terrestrial Magnetism and Atmospheric Electricity*, September, 1940.

[2]*Terrestrial Magnetism and Atmospheric Electricity*, December, 1930.

mosphere by charged extra-terrestrial particles from the sun, does the aurora become bright enough to be seen by the unaided eye. This is not to say, however, that aurora is unknown during sunlight hours, as Dr. Stormer often found aurora at the immediate sunset hour at the astounding height of 1000 km. (this would be near the H layer—per Dr. Harry Rowe Mimno), which evidently was the effect of the radiation pressure of sunlight (remember the effect on the tail of a comet) which was driving the earth's outer atmosphere out into space, as at that time the amount of sunlight would be tangent to the earth. After sunset, at least up to a height of about 4,000 km., the aurora would return to the normal 100-400 km. region.

Aurora Effect on Amplitude-Modulated Stations

The aurora effect on a.m. signals is relatively well-known, since these signals have a severe erratic fade and rough modulation or possibly a very evident tone modulation or high pitched hiss. These effects often prevent identification of the dx signal. Various comments on aurora a.m. phenomena can be found from time to time in Conklin's u.h.f. column.

Aurora F. M. Reception

The effect of aurora on f.m. has proven exceptionally interesting, since this involves the use of a "noise- and static-free" circuit. But on the other hand it is well to remember the effect of the bandwidth of 150 to 200 kilocycles as used in the commercial installations.

As is our usual practice in studying f.m. reception of weak signals[3], on November 12th, around 5:00 p.m., our attention was drawn to an apparent increase in the hiss level in the programs from the Alpine transmitter, W2XMN. This rise in the hiss or noise level seemed very peculiar since throughout the day the l.g.c.[4] had been varying between .60 ma. and 1.15 ma. in the long rolling fades singular to air boundary bending. In other words, a strong signal was being received. After checking on several fading amplitude modulated stations, it was all too evident that that evening we were to have an outburst of aurora.

Conditions remained the same—with the low volume high pitched hiss in the background—until 7:30 p.m., when the carrier roar of W1XOJ (43.0 Mc.) and W1XPW (44.10 Mc.) appeared out of the receiver rush to values of .35 ma. and .20 ma. respectively (the localization of air-boundary bending that day had been confining reception to the New York City area and W1XOJ-W1XPW were noticeably absent). Both stations were almost completely unintelligible as to program material. Only a few words were breaking through from time to time, and all was covered by a somewhat higher pitched rush than that of the normal f.m. receiver, combined with the usual erratic fade. The reader here might again take reference to the article on "Weak Signal F.M. Reception" in the December, 1940, issue of RADIO, where it is shown that signals with a .20 ma. up to .35 ma. l.g.c. reading should be 100 per cent readable and would begin to have a sizable portion of the receiver rush and noise suppressed.

Noting something strange about the varying pitch and intensity of this hiss, by retuning to W2XMN (still holding, but fading badly between .55 ma. and .90 ma.) we found that the unmodulated "resting" f.m. carrier was free of this particular disturbance, but then it became so decidedly unsteady during those intervals that the l.g.c. meter jumped spasmodically between .20 ma. and .65 ma. with a new crackling sound in the background and a dull roar like thunder also coming in on peaks. Then with the slightest rise in modulation the hiss began, making speech readable only with extreme difficulty and musical selections severely distorted.

As the aurora grew stronger as the time of maximum intensity approached, the hiss also rose in strength accordingly. By this time W2XWG, 43.90 Mc., W2XOR, 43.50 Mc., and W2XQR, 43.20 Mc., were now occupying their respective channels with a combination of the natural receiver weak signal roar and high pitched hiss of the aurora. W2XQR being the strongest at .15 ma., followed by W2XWG at .10 ma. and W2XOR, who were using vertical polarization, at .05 ma. By 8:15 p.m. the 900 kilocycles between 42.70 Mc. and 43.60 Mc. was nothing but a terrific jumble of wobbly roars and not a single signal was readable to any extent!

Fifteen minutes later conditions cleared slightly and again a few words every now and then from those stronger dx stations could be caught. In this respect W1XOJ was at all times the most readable, although it is the most distant (243 miles). A change of antenna from our normal horizontal to a vertical dipole, provided another surprise when only a weak roar on 43.50 Mc. (W2XOR) could be heard. This

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[3]Ferrell, "Weak Signal F.M. Reception," RADIO, December, 1940, p. 11.

[4]Limiter grid current, which serves as an indication of carrier strength. See article referred to in footnote (3). EDITOR.

indicated that polarization, strangely enough, was effective to the utmost, for even on the stronger channel of W2XMN (averaging .60 ma. on the horizontal) a strength reading could not be taken!

By 8:40 p.m. all signals were steadying, but dropping in strength, until on the W2XOR, W1XPW, W2XQR, W2XWG and W1XOJ channels only a squishing roar could be heard. W2XMN, meanwhile, fell to fades between .05 ma. and .35 ma.

Early the next morning (Nov. 13) a small portion of the hiss still remained and we were able to repeat our experiments on the "resting" f.m. carrier to our satisfaction. The unmodulated f.m. carrier has no high pitched hiss, but is nevertheless severely unsteady, while modulation steadied the strength, in this instance from jumps between .15 ma. to .60 ma. to a steady .25 ma., with all the high notes of music distorted. This was at 11:00 a.m. and by 2:00 p.m. that afternoon all channels had resumed normal lower tropospheric bending type conditions.

Geomagnetic Conditions

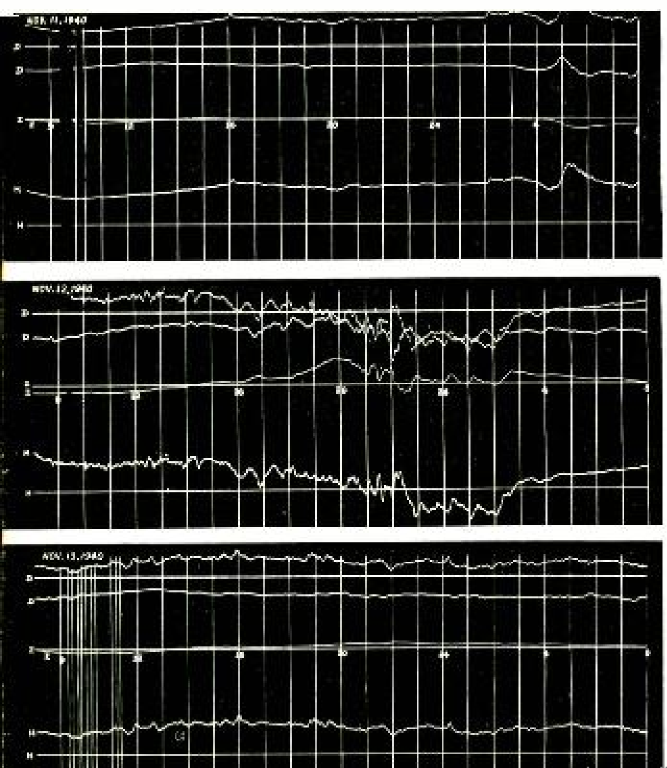
From the *Cheltenham Magnetic Observatory*, by the U. S. Coast and Geodetic Survey: "A magnetic storm did occur during that period, starting at the Maryland station at 2:06 a.m., e.s.t. on November 12 and lasting until about 3:00 a.m. (or later with reduced intensity) on the 13th. It was a moderate disturbance with irregular pulsations, the range in horizonal intensity being about 120 gammas (.0012 c.g.s. electromagnetic units). The maximum in horizonal intensity occurred at 5:14 a.m., e.s.t. on the 12th, and the minimum at 1:04 a.m. on the 13th. From other observatories, it is known that this was a world-wide storm."

Auroral Propagation

From all the foregoing data we are able to conclude that aurora type dx signals are to be classified under the heading "scattered reflections." But, also classified under that same heading are sporadic-E signals and the unusual complex, jumpy type signal reflected by the G layer. Both of these, however, are accompanied by some degree of skip. And it is noted that during auroral disturbances even an absorbing layer may be formed at low heights or the ionic-density of the layers may be so greatly diminished that reflection from these layers would be impossible.

The reports and comments of amateurs has been exceptionally valuable, since through their efforts we have been able to verify the fact that the horizonal directivity of these aurora signals is, regardless of the true azimuth of the dx station, northwest through north to northeast, or, rather, towards the zone of maximum aurora. This naturally shifts erratically across the heavens during the disturbance. Therefore, we assume that these signals are reflections at obtuse angles to the plane of the earth's surface and more than likely from the aurora curtains themselves or from clouds or patches, as you will, of electronic matter that

[*Continued on Page 74*]



Photostats of curves traced by the new Eschenhagen Magnetograph at the Cheltenham, Md., observatory of the U. S. Coast and Geodetic Survey for the period of November 11 to November 14, 1940.

Each reproduction carries curves or traces of horizontal intensity, vertical intensity and vertical declination, which are marked H, Z, and D, respectively. The straight lines similarly marked are the corresponding base-lines. In addition, there is an extra H trace at the top of each reproduction, which is not marked and which may be disregarded. The vertical lines are hour marks, and refer to eastern standard time according to the 24-hour clock. On the originals the distance between the base line and the traces can be measured to give the absolute intensity or declination.

On the 12th the storm begins at 2:06 a.m., as indicated by the sudden upswing of the H line. This is followed by irregular pulsations until maximum intensity is reached at 5:14 a.m. More irregular variations follow until the storm ends on the morning of the 13th. Note the increasing vertical intensity starting at 2:30 p.m. on the 12th and reaching a maximum near 7:40 p.m. that evening, which was near the time of maximum aurora disturbance. Note also that the horizonal intensity drops while the vertical increases, with H reaching a minimum at 1:05 a.m. on the 13th.

A Practical

PEAKED AUDIO AMPLIFIER

By W. W. SMITH,* W6BCX

An inexpensive peaked audio amplifier that gives 60 cycles selectivity with steep sides and a minimum of "hangover." Unwanted signals over 100 cycles off tune are attenuated several R points. When the filter is used, melodious overtones are imposed on a signal, thus avoiding ear fatigue. The filter may be cut out at will.

Ever since R. B. Bourne's acoustic filter[1] appeared more than ten years ago, amateurs have shown a cursory interest in audio filters as a means of obtaining selectivity for c.w. work. The fact that audio filters are not widely employed by amateurs is not a result of anything inherently wrong with the idea of utilizing sharp audio selectivity, but to the shortcomings of virtually all of the electrical a.f. filters that have been offered for amateur use.[2] Usually these have been comprised essentially of a single tuned choke or audio transformer.

While it is possible to obtain a high order of selectivity at audio frequencies with a single high-Q tuned circuit, such a filter would have a sharp nose, wide skirts, bad "hangover," and would require an expensive high-Q choke. Such chokes are not available for less than approximately $15.

By making use of several moderately low Q resonant circuits, it is possible to construct at a fraction of the cost of a single high-Q choke a peaked amplifier having all the selectivity one can use comfortably, and much better characteristics.

True selectivity does not simply mean a sharp "nose," but calls also for narrow "skirts." It is for this reason that broadcast receiver manufacturers do not try to get by with a single high-Q i.f. transformer, but rather, in the case of the better receivers, use several transformers.

When employing audio selectivity for c.w. work, we are not interested in how wide the pass band is at 6 db down, but rather at 30 or 40 db down. When the selectivity is obtained from several cascaded circuits instead of a single high-Q circuit, we can obtain the same attenuation with less hangover, or more attenuation with the same hangover. The peaked audio amplifier shown in the accompanying diagram, for instance, has about the same "top" and about the same hangover as a single 465 kc. crystal filter adjusted for just slightly less than the maximum obtainable selectivity. The attenuation to a signal 200 cycles off the peak, however, is much greater than for a crystal filter, the latter having an attenuation approaching 6 db per octave on the skirts until the frequency is high enough that the selectivity of the i.f. transformers begins to come into play (usually about 2 kc. off resonance).

The ideal arrangement would appear to be a combination of crystal filter and audio filter, the crystal filter adjusted for just sufficient selectivity to remove the audio image and provide single-signal reception.

In spite of the fact that the audio filter by itself does not eliminate "repeat tuning," its incorporation in a receiver lacking a crystal filter is very much worth while. A $29.95 amateur superhet can, for less than ten dollars, be converted to use the audio filter described. Even a simple autodyne will do wonders in pulling

*RADIO.

[1] *QST*, August, 1928.

[2] This does not apply to the combined mechanical-electrical transducer recently announced by a prominent manufacturer.

signals out of the QRM when this peaked amplifier is employed, provided that loose antenna coupling is used with the receiver to prevent blocking of the autodyne detector by loud signals. Any autodyne with sufficient output to drive a pair of phones satisfactorily (such as a "detector and one step") can be used to feed the peaked amplifier. The peaked amplifier requires a signal on the order of from 1 to 10 volts, which is typical of the output of a diode detector in a superheterodyne.

Noise Limiting

With the pass band limited to approximately 60 cycles, both impulse and fluctuation noise are reduced to a very low value. As the crest voltage of impulse noise varies as the band width and the r.m.s. value varies as the square root of the band width, the ratio of peak to r.m.s. is so greatly reduced that there is little point in attempting to employ an a.f. peak limiter. In other words, the high peaks are automatically chopped off (in effect) by the action of the filter.

Addition of a peak limiter ahead of the peaked amplifier would result in a slight additional reduction in impulse noise, but the limiter would so distort loud signals reaching it that the harmonics generated would permit such signals to sneak through the filter when ½, ⅓, ¼, etc. the resonant frequency of the filter. For this reason the incorporation of a peak limiter preceding the tuned amplifier is not recommended.

For the same reason (generation of harmonics which might get through the filter), it is important that any a.f. stage ahead of the filter be capable of handling high signal levels without distortion. If this precaution is not taken, a loud local signal 300 cycles away from a desired signal may overload the a.f. stage and the second harmonic thus generated get through the peaked amplifier, which is tuned to approximately 600 cycles.

The available power output to the speaker deliberately is limited for several reasons. The 6N7 will deliver about 600 mw. at 250 volts or about 800 mw. at 300 volts with distortion tolerable for voice work. With speakers commonly employed with amateur receivers, this represents usual room volume. Above this the output rapidly flattens off with increased signal, thus providing a degree of peak limiting when the filter is cut out and the receiver is being used for phone. With a very efficient speaker, such as a 12 inch p.a. dynamic of good make, the volume may be too loud for comfort when the gain is increased to the point of maximum tolerable distortion. In this case a resistor equal to the voice coil impedance should be placed in series with the voice coil. This will reduce the level nearly 6 db.

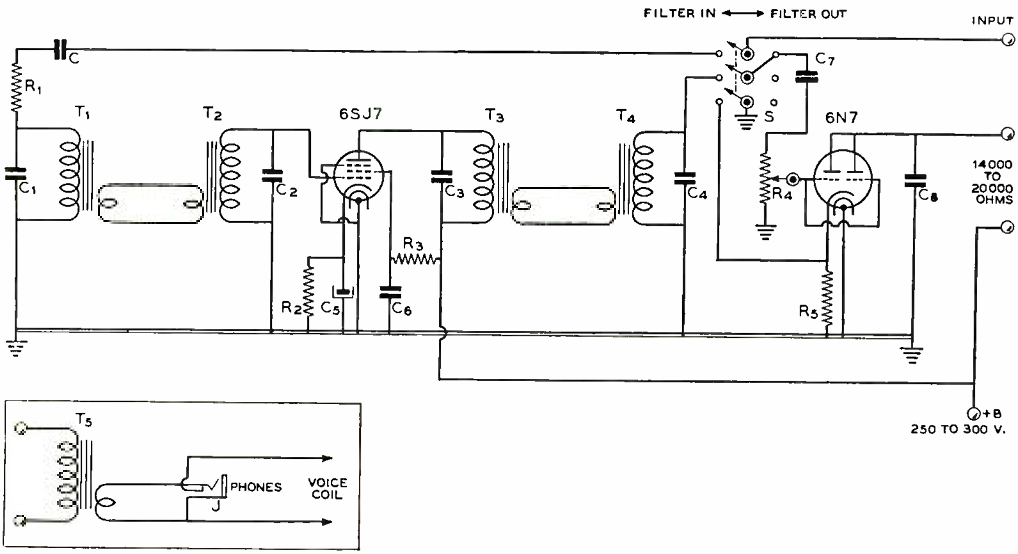
To obtain peak noise limiting action, simply run up the volume control until the voice intelligibility begins to be affected. The only drawback to this system of noise limiting is that for maximum limiting the signal must always be run at the same volume unless a variable resistance (of say 25 ohms) is placed in series with the voice coil.

On c.w. the "limited output output stage" also is of advantage. As one tunes over the band there is no danger of loud locals knocking one's hat off, because the maximum power output regardless of distortion is in the neighborhood of 1 watt. With the filter in use there is little noise reduction to be obtained by peak limiting in the output stage, as already explained, but it is nice to be able to spin the tuning dial of the receiver without danger of the speaker jumping out of its cabinet. If signals are excessively loud with the gain control full on, resistance should be inserted in series with the speaker voice coil as recommended for phone operation. The correct value of resistance for phone will be found about optimum for c.w.

If the speaker voice coil impedance is 4 ohms or more, sufficient headphone volume for c.w. can be obtained by feeding the phones from the voice coil winding, as shown in the wiring diagram. With the arrangement shown, the speaker is automatically disconnected when the phones are plugged in. The same limiting of loud signals is obtained with headphone operation when the phones are fed in this manner, because the 6N7 must deliver its full output to produce a fairly loud signal in the phones.

When the filter is cut in for c.w. operation, the cathode bias resistor for the 6N7 is shorted out. With 1 meg. of grid resistance the positive peaks are effectively lopped off under these conditions of zero bias, producing considerable harmonic distortion. The effect of the overtones is quite pleasing, and there is none of the fatigue that comes from copying a pure sine-wave tone for a long period of time. Because the cathode resistor value is such a small percentage of the plate load impedance of the 6N7, the cathode bypass condenser has been omitted with but an imperceptible decrease in gain. Condenser C_7 is required to prevent a grid return to ground through T_4, with consequent loading of the tuned circuit on alternate half cycles and broadening of its resonance peak.

After many checks and much controversy, a frequency of between 550 and 600 cycles was chosen for the filter, and the specified values for the tank condensers will, with the specified inductances, peak at slightly less than 600



PEAKED AUDIO AMPLIFIER CIRCUIT.

The filter may be cut in or out of the circuit by means of switch S. If the input lead is long, low-capacity (crystal microphone type) shielded wire should be used. If the amplifier is integral with the receiver, the lead need not be shielded.

C—.002 µfd., mica
C_1, C_2, C_3, C_4—.05 µfd. 400 v. paper tubular condensers (all of same manufacture)
C_5—25 µµfd. 25 volt electrolytic
C_6—0.1 µfd. paper tubular, 400 v.

C_7—.001 µfd. mica
C_8—.006 µfd., paper or mica, 600 v.
R_1—500,000 ohms, ½ watt
R_2—750 ohms, ½ watt
R_3—100,000 ohms for 250 volt supply, 150,000 ohms for 300 volt supply, ½ watt

R_4—1 meg. pot., a.f. gain taper
R_5—50 ohms, ½ watt
T_1, T_2, T_3, T_4—Small, identical, 6.3 volt filament transformers. (Refer to text regarding orientation and polarity of T_1 and T_2)

T_5 — Output transformer to reflect 14,000 ohm load for particular speaker used.
J—Closed circuit jack to kill speaker when phones are plugged in.
S—Three pole double throw rotary switch

cycles. While the peak could be shifted lower or higher in frequency at will by incorporating various values of capacitance in conjunction with a switching arrangement, the necessary circuit complications did not appear to be justified. A word might be in order, however, to those who wish to experiment with the pitch. The condensers should not be made less than about .02 µfd., nor greater than 0.1 µfd. The width of the pass band will be greatest with the lowest values of capacitance, and vice versa, or roughly proportional to the resonant frequency.

The Tuned Tank Circuits

Many chokes, a.f. transformers, and a.c. transformers were checked in a search for an inexpensive inductance having the desired order of inductance and not too low a Q, something of standard manufacture commonly stocked throughout the country. The best bet appears to be the Thordarson type 19F81 midget six-volt filament transformer.

The air gap or butt construction commonly employed in small chokes and output transformers designed to carry d.c. reduces their Q, and the Q of the small filament transformers chosen is considerably better than that of the best inexpensive filter choke. Also, the low value of inductance is better adapted for the job.

The Q of these transformers when used as inductances appears to be in the neighborhood of 5 at the audio frequencies with which we are concerned. Because of the difficulty in measuring values of Q less than 10 except with the aid of special equipment, an accurate determination of the Q could not be made.[3] How-

[3]The common method of determining Q by comparing the impedance at the frequency for which it is maximum (resonance in the case of a high Q circuit) with the impedance at 0.7 or 1.4 times

ever, the important thing is that it happens to be just right for the order of selectivity desired when the transformers are used as shown in the diagram.

The inductance of each of a number of such transformers was checked to determine the manufacturing tolerances. Fortunately, all were practically "on the nose." However, to minimize the chance for disparity in the inductances, it might be wise to obtain four transformers which the dealer is sure came from the manufacturer in the same shipment.

Next, with no little trepidation, the capacity tolerance of a number of tubular paper condensers was checked. The result was a pleasant surprise. The capacity variation in a number of condensers of the same make was less than plus-minus 1 per cent. When random makes were tested (all of good grade, however) the tolerance was found to be better than plus-minus 2 per cent. Apparently no especial care or sorting is required in the manufacture of paper tubular condensers to ensure close tolerances, as is necessary with mica condensers. To minimize variations, the tubular condensers C_1, C_2, C_3, and C_4 should all be of the same make, type, and voltage rating.

Another reason for choosing the particular transformers specified was that a pair of 6.3 volt filament transformers can be "link inductive coupled" conveniently to give the desired amount of coupling, thus realizing the advantages that are obtained by using a pair of coupled circuits as compared to two isolated circuits.[4]

Construction

No particular care need be taken in the construction of the amplifier except for the mounting of the transformers. The amplifier either may be constructed as an integral part of a receiver, or attached as an outboard unit. In the latter case the input lead should be shielded and kept as short as possible. To prevent excessive loss of highs on phone, low capacity shielded cable should be used (crystal mike cable) when the amplifier is fed from the diode load resistor of a diode detector.

T_1 and T_2 should be mounted at least 8 inches from T_3 and T_4, and at least a foot from any power transformer. The former precaution is necessary to avoid feedback, the latter to avoid hum pickup. The level is sufficiently high at the grid of the 6N7 that there is little danger of T_3 and T_4 picking up hum unless mounted bang up against a power transformer.

Hum picked up by T_1 and T_2 is manifest as high order harmonics falling within or near the pass band of the amplifier. If T_1 and T_2 are mounted immediately juxtaposed, with the planes of their laminations parallel, hum pickup virtually can be eliminated simply by poling the windings correctly. An effective "hum bucking" transformer is the result. If a high pitched hum should be present, simply reverse the filament winding leads.

Remember that for maximum hum bucking action T_1 and T_2 should be mounted as close together as possible (with the winding insulation touching), so that the distance from T_1 to the source of hum is but little different (in percentage) from the distance between T_2 and the source of hum. As the source of hum usually will be several stray fields (or a distorted field), there is no point in trying to make the distance between the power transformer and each of the two transformers T_1 and T_2 exactly the same.

It is unlikely that the 6SJ7 stage should oscillate due to capacity feedback through switch S. However, if such oscillation should occur, due to excessive capacity between switch contacts, the filament winding coupling leads between T_3 and T_4 should be reversed. If this does not effect a cure, a switch with less capacity between contacts will be required.

The output transformer T_5 may be made part of the amplifier or mounted on the speaker or in the speaker cabinet. If integral with the amplifier, it should be placed a foot or more from T_1 and T_2, though there is no need to keep it away from T_3, T_4, or a power transformer.

The gain of the amplifier with the filter in is somewhat greater than with the filter cut out for phone work or c.w. "reconnaissance." This was deemed desirable because the signal to noise ratio is vastly improved when the filter is cut in, and much more gain can be used. Under such conditions one could design the amplifier so that when the filter was cut in the

[*Continued on Page 73*]

frequency is not practicable when the Q is low and virtually all of the circuit resistance is in one branch (the inductive branch in this case).

The impedance of parallel resonant circuits falling in this class is not maximum at resonance; hence, strictly speaking, the pass band is at *peak impedance,* rather than at "resonance."

[4]When the two circuits are tightly coupled, the top of the impedance curve is broadened slightly without affecting the slope of the sides. While such things as critical coupling, double hump response, etc. are not so apparent in the case of two *low Q* coupled circuits, nevertheless there is a broadening of the "top" when the coupling is tight.

The pass band can be narrowed slightly by utilizing only half of each filament winding for coupling, but is sufficiently narrow when the whole winding is used.

Mechanical Methods for

TERMINATING ANTENNA FEEDERS

By W. E. McNATT,* W9NFK

Methods of handling the lead-in problem are an old story to the experienced amateur. The newcomer, however, is usually left to his own devices in handling this simple job, which may often appear perplexing. This is especially true when the installation is made on rented or leased property, or upon that of parents. Complications may also result from the stringent requirements of an x.y.l. who insists upon neatness in the outer appearance of the home. Hence, the author presents several suggestions which may help the oldtimer as well as the newcomer.

If a station is located in the house proper, i.e., bedroom, "spare bedroom," living room, etc., the owner, amateur or not, usually insists on a neat, orderly installation of all wiring, especially antenna feeders. One of the simplest, but not too efficient, methods of bringing in antenna leads is merely to raise the window, draw the wires through, and drop the window on top of them. In any case, and especially in wet weather, this method is none too satisfactory, and is recommended only for temporary installations. Another system, which requires no little skill in handling glass, is to drill the required holes in the window pane through which the feeder wires are to be passed. Aside from its mechanical faultiness, this procedure also involves the possibility of breaking the window through some accidental jerking on the wires through the glass.

Simple, Neat and Effective

One of the simplest and neatest means of bringing feeders into the operating room (when the walls cannot be drilled) is shown in figure 1. Here a panel of masonite of the appropriate size is fitted with a strip of plywood on its top and bottom edges, and is inserted between the bottom of the lower pane and the sill. The drawing shows how a number of feed-through insulators may be mounted on the panel, which may be used simply as a feeder termination board, or can also contain antenna coupling devices. Standard feed-throughs with nuts at each end can be used, although the use of jack-type insulators on the room-side of the panel permits flexibility in antenna connections. In the drawing, the large (top row) insulators are intended for transmitting antenna feeders, the second row being for receiving antenna terminations, either two-wire open spaced or twisted pair lines, while the small insulator at the bottom center is a ground connection to an outside water pipe if none is available within the room.

For those conscientious objectors to cold weather, a strip of heavy sheet rubber[1] may be screwed to the top of the window frame, so that it effectively blocks the opening created when the window is raised to accommodate the

*Ex-W6FEW, Managing Editor, RADIO.

[1] "Airfoam" is obtainable from athletic supply stores, or from commercial rubber goods suppliers.

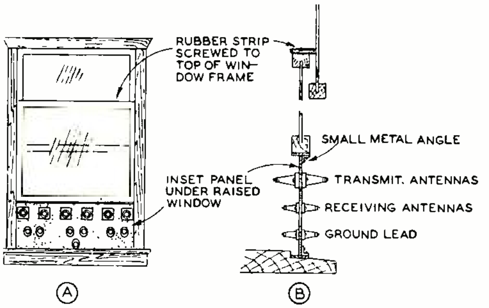


Figure 1.
Little time is required to assemble and install this neat arrangement for bringing antenna feeders to the operating room. This type of installation is well fitted to temporary or semi-permanent locations.

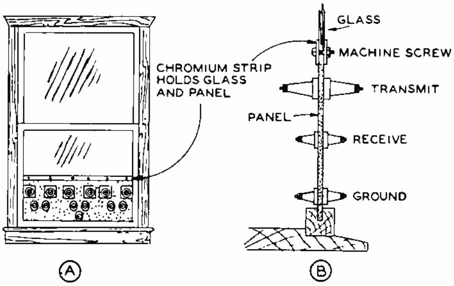


Figure 2A.
For permanent installation, the panel is made a part of the window sash, with the glass. Details are described in the text. Figure 2B. Illustrating the use of ornamental chromium strip to conceal the joint between the glass and the feeder panel, when the latter is installed in the window sash. The panel is masonite and the insulators are the ordinary variety readily available.

feeder panel. This is illustrated in detail in figure 1. This method is one of the neatest and least harmful (to woodwork and glass)—and is especially adaptable to installations which will be of only a few weeks duration.

An Improved Arrangement

For a permanent installation, an elaboration on the foregoing method is illustrated in figure 2 and figure 2A. Here the panel is much the same as that previously described, the main difference being that it is installed permanently in the window sash (frame holding the glass). The sash is removed from the frame, the glass from the sash. A glass cutter is brought into play, and a piece of glass the size of the panel plus 1/8 inch is cut. Then the other piece of glass and the panel are placed in the sash so that 1/8 inch clearance remains between the panel and the window, and two pieces of chromium-strip trim (available from hardware stores) are then bolted over the opening, the 8-32 or 10-32 bolts passing through the clearance between glass and panel. In this way, both glass and panel are rigidly supported and the joint between glass and panel is attractively concealed.

In this type of installation the panel material should be approximately the same thickness as that of the glass. Usually, a piece of 1/8 inch masonite will admirably serve the purpose. If, however, the glass is thicker than the panel material, or vice versa, the thinner of the two should be built up on the weather side with a piece of felt or cardboard strips, so as to effect a neat, finished appearance with the chromium trim.

Displacing Feeders

In instances where it is desirable to have the feeders rise vertically at some horizontal distance from the side of the house, a framework similar to that shown in figure 3 will prove effective. The framework is assembled of wood strips, of dimensions corresponding to the particular requirements at hand. This framework mounts directly on the weather side of the panel, and thereby creates a complete feeder termination rack. It is strongly recommended that the rack be assembled with wood screws and given several coats of paint, not only for the sake of appearance, but for protection against weather. The main function of the rack is to place the feeders away from the house by a distance sufficient to keep them from banging against the side of the house on a windy night, or to place them out of reach of "tiny hands." Many a Junior Op has grabbed a fistful of r.f. while playing with papa's wires.

The sketch of figure 3 should clearly indicate the simplicity of the rack, with but one or two points needing explanation. The pipe appearing at the extreme right of the side view is a guard to prevent twisted pair receiving antenna feeder lines from becoming frayed. As they rub against the pipe they will contact a round, smooth surface, otherwise they would scrape their insulation on the sharp corner of the board above. Use of the pipe for this purpose might at first seem a superfluous elaboration. However, it also serves to remove the twisted pair lines from the immediate vicinity

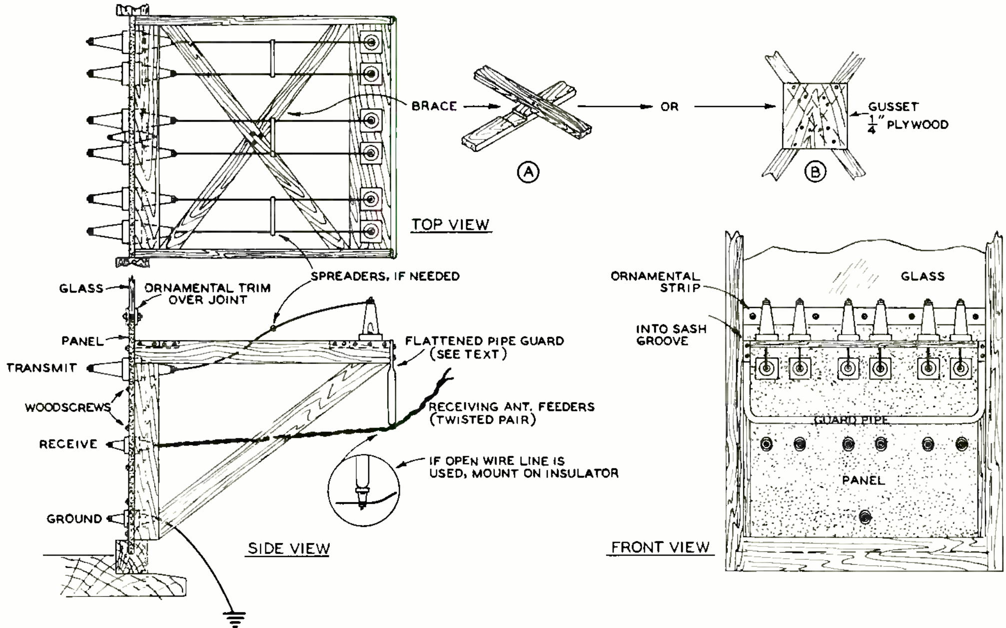


Figure 3.

When it is desired to remove, by some horizontal distance, the point at which the feeders rise vertically, a rack similar to that shown here may be used. It is easily assembled, and is constructed of 1" by 2" pine, or other soft wood. The rack is mounted on the panel by wood screws. The guard pipe is to prevent twisted pair feeders from becoming frayed, or from swinging too close to the transmitting antenna feeders above. If open two-wire lines are used in place of twisted pair, they are prevented from short-circuiting by small standoff insulators mounted on the pipe, as described in the text. At A and B. Showing two methods by which the joint of the braces shown at point A (in top view of figure 3) may be made.

of the transmitting antenna feeders above. In the event open spaced lines are used for feeders to the receiving antenna, they can be prevented from short-circuiting on the guard pipe by mounting them on small insulators on the guard pipe. It should be readily apparent that one does not necessarily have to make a Chinese copy of this setup. In other words, the guard can be a rounded piece of wood (1-inch dowel or broom stick) on which necessary insulators may be mounted. Or, if extremes of elaborateness are desired, no insulators need be necessary if a strip of lucite or polystyrene is used as the guard bar.

The whole purpose of this article is to present a few ideas which may or may not be followed in their entirety, or which may be perfectly well expanded into better ideas.

The other item requiring explanation is the junction of the two cross braces shown in the top view of the rack. Almost anyone who has ever picked up a saw can effect a neat notched joint as shown in the detail of A. If, however, this degree of workmanship is considered too bothersome, a simpler joint may be constructed as in B of figure 3. In this, one cross piece is solid and the other is cut. The two pieces of the cut member butt against the solid member and all are joined by a gusset plate of quarter inch plywood and wood screws.

The Underground Situation

Thus far, this article has dealt with antenna leadins to transmitters located in rooms above ground. For the benefit of those amateurs having their stations in basement apartments or the basements of their homes, the writer offers the suggestions shown in figures 4, 5, 6, 7, 8 and 9.

In figure 4, the same type of panel as suggested earlier in this text is mounted in the basement window. The feeder wires run up the side of the house to a point well above ground. This point should be about 8 or 9 feet, so that free swinging feeders will be out of reach. If there are children in the family,

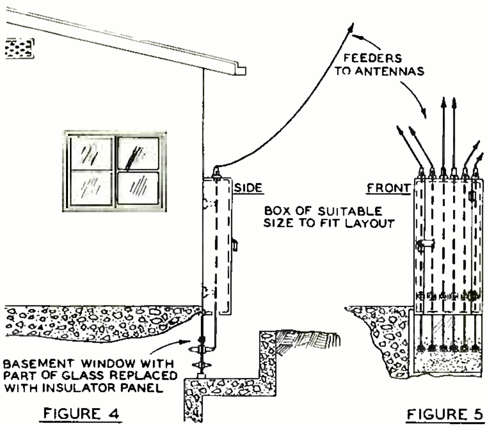


Figure 4.
Illustrating how feeders may be guarded from tampering when the station is located in a basement room. A three-sided wooden cabinet is constructed in such dimensions so as to cover the feeders to a height which is out of reach of children. Figure 5. Front view of the covering illustrated in figure 4 and described in the text.

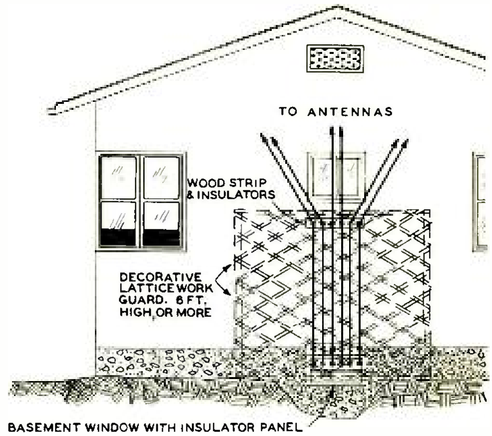


Figure 6.
If the type of covering illustrated in figures 4 and 5 does not meet the approval of x.y.l. or landlord, etc., a decorative latticework guard may be erected around the feeders to protect them from being tampered with. This requires an inexpensive amount of wood and lath material.

or among the neighbors, it is recommended that the added refinement of an enclosure be added around the feeders. This enclosure is simply a three-sided cabinet constructed of light materials (one-inch pine or other wood—even masonite), which is mounted over the feeders and attached at several points to the side of the house.

Some ingenuity may be required where the building is of brick or stucco, but your local lumber yard can usually give suggestions as to how connections may be made to the outer wall material with a minimum of damage. The enclosure is shown in the diagram of figure 4. The top serves as a mounting board for insulators, to which the feeders proper are connected. These insulators do not necessarily have to be the feed-through type, as is illustrated in the detail of A. A hole sufficiently large to give ample clearance to the feeder wire is drilled in the top of the enclosure. Directly over this is mounted an ordinary standoff insulator.

A front view of this arrangement is shown in figure 5. The door provides access to the interior for the purpose of cleaning out cobwebs, inspecting or installing additional insulators and feeder wires. A lock will usually be found necessary to bar access to the cabinet, which may easily become a modern "Pandora's box" to the neighborhood dead-end kids.

Diplomacy à la Latticework

The possibility that the landlord, x.y.l., etc., may object to the necessary carpentry work required in this installation, leads to the suggestion of figure 6. It would seem that only the most unreasonable persons would object to a neat latticework grill, painted so as to blend with the color scheme of the house and surrounding yard, and on which wire-concealing vines might grow. This gives rise to the alternative of replacing the previously described enclosure by such a decorative latticework guard around the feeder lines. If the x.y.l. objects to this method, you might as well give up her, or ham radio. If the landlord objects—you can always move, or let matters ride as they stand, and remember to put the item in your next lease agreement.

The grill may be easily constructed, and requires nothing more than a few pieces of 1″ x 2″, about half a bundle of lath, plus some paint of an appropriate color, and nails. If the x.y.l. or family seizes upon this as an excuse to grow some form of clinging vine, be sure to grant them permission to do so only with the provision that they trim the interior of the grill at frequent intervals, to prevent cooked vines, à la r.f., showing up in the family meals. R.f. is not good for the vines, generally speaking, and—what is more important—vines are distinctly not good for r.f.

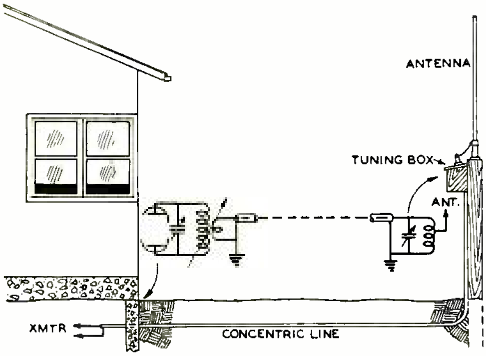


FIGURE 7

In basement locations, the amateur using concentric line may effectively conceal it by laying it underground to the antenna pole. The vertical antenna is shown here merely for purposes of illustration.

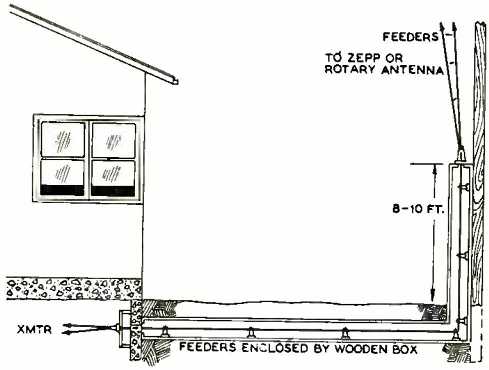


FIGURE 8

When two-wire open spaced feeders are used at a station located in the basement, they may be inconspicuously run to an antenna pole by mounting them on insulators in a box, which is buried. At the point where the feeders rise vertically, they are guarded against tampering by a wooden shaft, which rises eight to ten feet above ground. Details are given in the text.

Some Subterranean Suggestions

About three years ago the writer had occasion to describe the installation of a vertical antenna[2]. The owner of the antenna, at W7DTJ, located his station in the basement of his home. Since installation was such that a feeder above ground would have interfered with passage in the yard, it was decided to take the only other way out and bury the feeder below ground. Since it was a concentric transmission line, the burial was easily done with an expenditure of little physical exertion, the work requiring only the spading of a small trench about three inches wide, and laying the line (copper tubing) a foot or so below ground. Such an installation is illustrated in figure 7.

The principal difficulty with this method is that concentric transmission line is used by comparatively few amateurs having their stations in basement rooms. Therefore, the suggestion of figure 8 is offered as a possible "way out" where feeders are of the two wire open-spaced type. This also involves some digging up of *terra firma,* the consequent mess lasting for a few hours on a Sunday. A wooden box is constructed of such width as to accom-

[*Continued on Page 80*]

[2]McNatt and Steiner, "The Story of a Vertical," RADIO, January, 1938, p. 38.

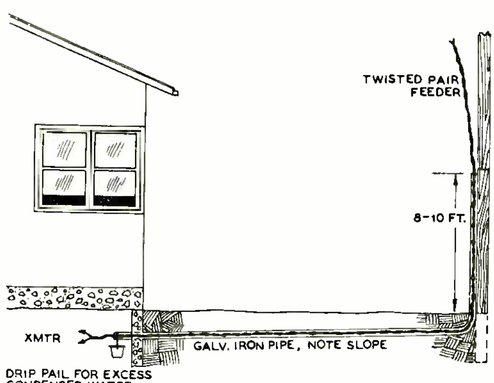


FIGURE 9

Another method of concealing transmission line below ground. In this instance EO-1 or other twisted pair feeders are protected by a piece of galvanized iron pipe, which runs to the antenna pole and thence upward a number of feet. The top of the pipe should be covered in some manner so as to prevent entrance of snow or rain. The horizontal portion of the pipe is laid at a grade which will carry the water resulting from condensation into the drip pail in the station. For maximum performance, only the best twisted pair cable should be used.

The v.t.v.m. removed from its cabinet. The power transformer, metal rectifier and the two voltage regulator tubes are in a line, from right to left across the rear of the chassis. Rubber grommets are used to insulate the meter terminals where they pass through the panel.

Regulated A.C.-D.C. VACUUM-TUBE VOLTMETER

An inexpensive instrument for the measurement of d.c. and audio-frequency a.c. voltages—a very useful device when only a limited amount of current can be drawn from the voltage source.

Of all the measuring equipment usable by the amateur and experimenter, the vacuum-tube voltmeter is probably one of the most useful single instruments. Yet, in spite of its wide utility, it is very seldom that the v.t.v.m. is actually found in the hands of the amateur or experimenter. For some reason there seems to be a mistaken belief that the instrument involves some mysterious principle of operation and that its use requires much knob twisting and continual reference to calibration charts. Actually, the v.t.v.m. can be extremely simple to construct and use, as we shall see.

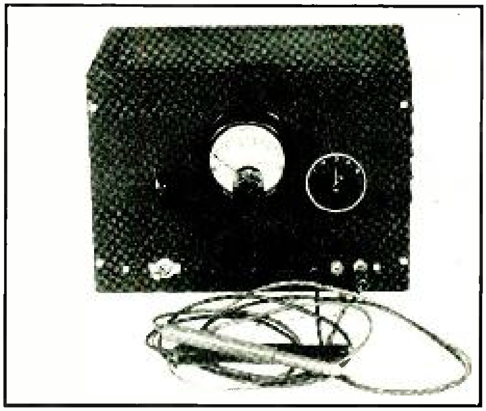
For some time the simple field-strength meter first shown in the April, 1938 issue[1] has served RADIO's lab in the dual capacity of field-strength meter and v.t.v.m. However, it has received so much use as a v.t.v.m. that the replacement of batteries, which were originally intended to operate the unit only intermittently as a field-strength meter, had become a distinct annoyance. In addition, the field-strength meter has a rather restricted range of usefulness, being limited to use with voltages between .5 and 5 volts. In spite of this limitation it proved to be a very satisfactory instrument for many lab measurements. When it was necessary to read voltages beyond the range of the f.s. meter, a diode rectifier type v.t.v.m. was usually haywired together for the series of tests under way and then torn down when it was no longer needed. Finally it was decided that a permanent wide-range v.t.v.m. would save a considerable amount of time, and the unit shown in the accompanying photographs and diagram was built.

[1]*Dawley*, "An Inexpensive Field-Strength Meter," p. 17.

Circuit Possibilities

In casting about for a suitable circuit for the new unit several possible circuit arrangements were considered. One of the best of the v.t.v.m. arrangements is the slide-back type of meter. In this type of meter either a diode or triode may be used, although the triode is the more common form. In the triode slide-back meter the plate of the tube is given a d.c. voltage and the grid is biased near cut-off. With the v.t.v.m. input terminals tied together the plate current is noted, and then the unknown voltage is applied across the input terminals and the bias varied to return the plate current to its original value. The change in bias voltage required to return the plate current to its original value is equal to the peak value of the unknown voltage. The range of this type of meter is very wide. It is limited at the low-voltage end by the transconductance of the tube and the minimum change in plate current which the plate meter used will detect, and at the high-voltage end by the insulation at the input and the variable grid-bias voltage available.

The disadvantages of the slide-back meter are the necessity for two meters—one to indicate the plate current, and another to measure the bias—and the necessity of adjusting the slide-back voltage each time the voltage under measurement changes. To be sure, there are methods by which the slide-back voltage may be made to adjust itself automatically, and an "eye" tube may be used to indicate the plate-current reference point, but these features involve considerable complication of the circuit.



This inexpensive instrument has a.c. and d.c. ranges of 1, 10, 100 and 500 volts. The right-hand knob on the panel operates the range switch, while the knob at the left is used to balance the meter bridge circuit.

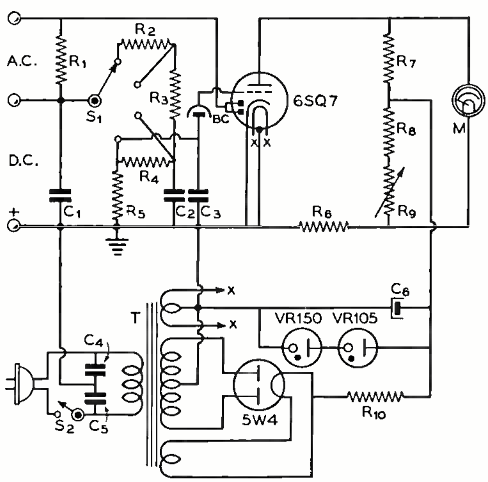
Square-Law Meter

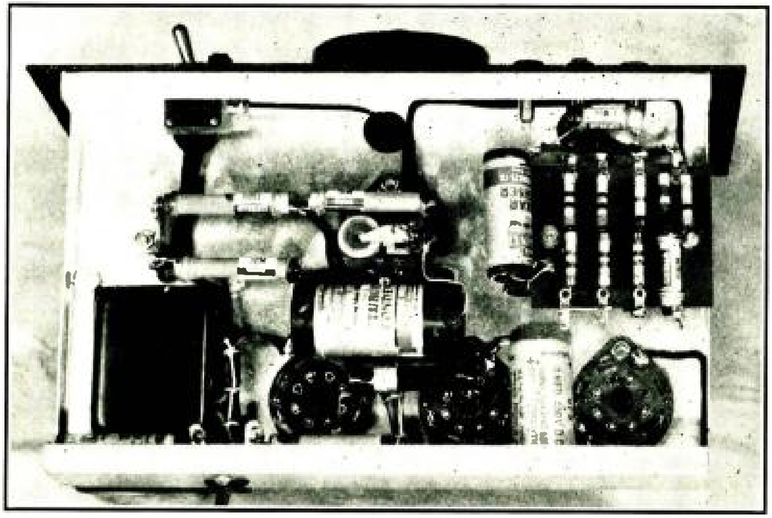
The square-law detector type of v.t.v.m. is another very useful instrument for certain applications. In fact, the combined field-strength meter-v.t.v.m. previously mentioned operates on this principle. The disadvantage of the square-law meter is its non-linear characteristic. The voltmeter tube's plate current varies directly as the square of the voltage impressed on the grid. This disadvantage makes a special meter face or a calibration chart necessary with the square-law type of instrument. The use of a calibration chart makes difficult a rapid estimation of voltage variations from relative meter readings, while special meter faces are difficult to obtain.

Figure 1.

Wiring diagram of the a.c.-d.c. vacuum-tube voltmeter.

C_1 — 0.05-μfd. 600-volt tubular
C_2—0.1-μfd. 600-volt tubular
C_3—0.5-μfd. 600-volt tubular
C_4, C_5—0.05-μfd. 600 volt tubular
C_6—8-μfd. 450-volt electrolytic
R_1—1.0 megohm, 1 watt
R_2—40 megohms (4 10-megohm ½-watt in series)
R_3—9.0 megohms (5 megohms and 4 megohms ½-watt in series)
R_4—900,000 ohms (400,000 and 500,000 ohms ½-watt in series)
R_5—100,000 ohms, ½-watt
R_6—30,000 ohms, 1½ watts
R_7—10,000 ohms, 1½ watts
R_8—1500 ohms, 1½ watts
R_9 — 1000-ohm potentiometer
R_{10}—2000 ohms, 10 watts
T—580 c. t., 50 ma.; 5 v., 3 a.; 6.3 v., 2 a.
M—0-1 d. c. milliammeter
BC—1¼-volt bias cell
S_1—Single-pole four-position switch
S_2—S.p.s.t. toggle line switch





There is plenty of space under the chassis for all components. The multiplier resistors are all located on the terminal plate seen at the upper right; a cabled set of leads goes through the chassis from the terminal strip to the range switch above deck. Note the bias cell and holder, which is supported by having one of its terminals soldered directly to the grid connection on the 6SQ7 socket.

Rectifier V.T.V.M.

Still another type of v.t.v.m. is the diode-rectifier arrangement. In this circuit a small diode is used to rectify the a.c. voltages, the rectified current being indicated by a low-range microammeter. The product of the current and the resistance of the diode "load" resistor gives the peak value of the applied voltage with tolerable accuracy. Unfortunately, if the diode rectifier instrument is to have high input resistance the resistor must be high in value, and the current available for the indicating meter is thus rather small, making it necessary to use an expensive, highly sensitive microammeter. One great advantage of the rectifier type v.t.v.m. is its linearity, the meter readings being directly proportional to the peak value of the voltage. We will come back to the rectifier instrument after discussing one more type of v.t.v.m.

For the measurement of d.c. voltages, a tube biased so as to operate on the linear portion of its grid voltage-plate current characteristic may be used. Such an arrangement will give a plate current variation which is linear in respect to changes in d.c. grid voltage in either direction over a range somewhat less than the bias voltage. One disadvantage of this type of instrument is that there is always current flowing to the plate of the tube when no voltage is applied to the v.t.v.m. terminals. When an unknown voltage is to be measured the plate current merely varies, said variation being an indication of the amount of voltage. This disadvantage may be overcome by placing the indicating meter in a bridge circuit in which the v.t.v.m. tube's plate resistance forms one leg of the bridge. The bridge is adjusted to balance (meter reads zero) when no voltage is applied to the v.t.v.m. terminals. When this is done the meter readings are still linear in respect to grid voltage, but they start from zero instead of from part way up on the scale.

A.C.-D.C. Meter

The above described type of instrument is a most effective d.c. vacuum-tube voltmeter. It is, however, of no value for a.c. measurements, since the tube is biased as a class A amplifier, and this type of amplifier does not show any change in plate current when small sinusoidal a.c. voltages are applied to its grid. When combined with the rectifier type v.t.v.m. previously mentioned, however, this circuit gives a simple and inexpensive a.c.-d.c. vacuum-tube voltmeter.

The circuit of the complete v.t.v.m. is shown in figure 1. The triode section of the 6SQ7 acts as a linear d.c. voltmeter, while the diode section is used as a rectifier for a.c. voltages. For a.c. measurements the rectified voltage is applied to the triode grid, while d.c. voltages to be measured are applied directly to the grid. The circuit is quite similar to that shown by Root in the February, 1938, issue of RADIO.[2]

A bias cell in the grid lead is used as bias for the triode, and voltages to be measured are applied as additional negative bias. When

[*Continued on Page 83*]

[2]p. 31.

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Sharp vertical directivity is fine when it is controllable; when it isn't controllable we can have too much. It is virtually impossible to get too much horizontal directivity in an array capable of being rotated. The obvious answer is an array with exceptionally sharp horizontal directivity but only moderate vertical directivity.

By DAWKINS ESPY,* W5CXH/6

The ability of the close-spaced multi-element horizontal rotary array to really do things is now commonly accepted. No one denies that they give considerable gain over a half-wave antenna on reception as well as in transmission. However, in looking over what the dx boys used for antennas in the 1939 Contest[1], it was noticed that almost invariably where rotary beams were mentioned by those who came out on top, the rotary played a secondary role to a higher gain and more consistent fixed antenna, and that the rotary had been used to "fill in the gaps." But what about the semi-city dweller, the class into which most of us fit; what can we do to give these antenna-farm owners some real competition when we have room for only one good directional antenna or a couple of rotaries at most?

Let's consider, for example, a two or three-element horizontal rotary beam, the type with which most of us are familiar. The vertical directivity pattern of this array is sharper than the horizontal pattern. Users of this type beam have often noticed that, when working dx of the medium and long-distanced kind, that there are very definite optimum times for contact. As conditions change, the optimum vertical angles of radiation for contact between two given points changes, and when this value is within the usable limits of our beam, we can have satisfactory communication. However, by broadening the vertical angle of radiation we might be able to increase the period of time over which a substantial signal can be maintained at a given point, and we can also improve our signal at points closer and farther than the optimum point.

Granted that the wider vertical pattern is desired, we might well afford to get it by sacrificing width of the *horizontal* pattern, because the beam will be rotary, and can be set to any direction. In other words, what we want is very sharp horizontal directivity, to get high gain, but not too much *vertical* directivity[2]. The simplest way to attain this is to use a *vertical* beam—that is, with the elements in the vertical plane. As for getting the increased gain, two half waves in phase with two directors and one reflector each are used.

Construction

The dimensions of the elements and spacing of the double-four vertical rotary beam are given in figure 1. They are, of course, suggested starting points to be used in the tuning procedure which will be discussed later. The elements are made of thin wall, ½ inch elec-

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*1939 N. Wilcox Avenue, Hollywood, California.

[1]Goodman, "Fashions in Antennas," *QST*, June, 1939.

[2]This assumes the array is not tiltable.—EDITOR.

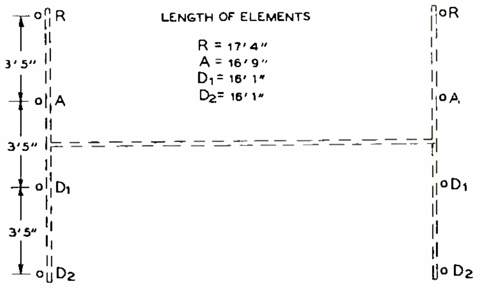

Figure 1.

LOOKING DOWN ON THE ARRAY, SHOWING ELEMENT SPACING.

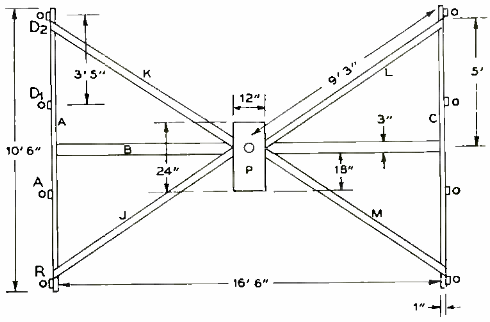

Figure 3.

TOP VIEW OF SUPPORTING STRUCTURE, SHOWING CONSTRUCTION DETAILS. The members G, O, etc., of figure 4 have been omitted for the sake of clarity. Refer to figure 4 for details.

trical conduit and in the final form of the beam on ten meters, were supported a distance of 3 feet above and below the main framework as shown in figure 2. The two vertical four-element portions of the array are separated by a distance of 16½ feet. Looking from the top, the main framework looks like a squashed H. Referring to figure 3, the pieces *a, b,* and *c* are made of 1 x 3's; the braces *f* and *g* are made from 1 x 3's; as shown in figure 4. The element arms *a* and *c* are braced by *j, k, l,* and *m,* which are of 1" x 2" stock. The brace tower is 3 feet high and made from two pieces, *n* and *o* of 1 x 3 stock; the two together form an inverted V which straddles the platform *p,* which is made of three pieces of 1 x 12 bolted together; the detailed construction of this is shown in figure 5. The elements are attached to the vertical arms with 1½" insulators and clamps which were made originally for fastening conduit to the wall. Pine wood was used throughout, and the screws were of brass.

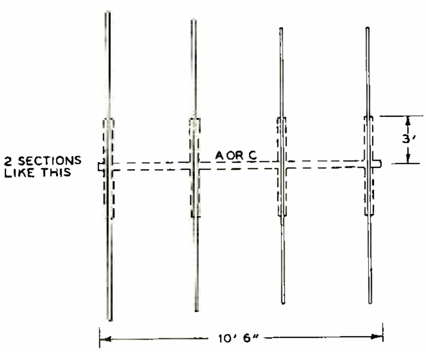

Figure 2.

SIDE VIEW, SHOWING ONE PANEL. SECOND PANEL IS IDENTICAL, SPACED ONE HALF WAVELENGTH FROM FIRST.

The center of each element was cut out for a distance of 6 inches and the gap closed by means of no. 12 bare copper wire clamped to both pipes as shown in figure 6. This makes it necessary only to loosen the clamps in order to slide the pipes in or out to change the length, and whatever gap is left in the center is completed by the wire. For example, if we are mounting a director, the final length according to figure 1 is going to be about 16'1". Subtracting 6 inches and dividing by two, we get 7'9½" for each of the two pipes that go to make up this element.

Feeding

To feed this array a Y match is made to each radiator and the feeders, spaced 6 inches, are brought into a matching box as shown in figure 7. In the matching box is a low-C condenser and a high-L coil which are tuned to the operating frequency. The open line is connected across almost all of coil; the outside of a concentric cable is connected to the center of the coil, while the inside conductor is tapped in either direction on the coil a turn or two until the final amplifier plate current at resonance reaches normal with a reasonable amount of coupling to the transmitter. The high L circuit makes for efficiency as well as broad tuning, so that relatively no change will be noticed in the transfer of energy over as much frequency change as the antenna itself will allow. The coil has 6 turns of quarter-inch copper tubing wound in air to a diameter of 3 inches and spread over a length of 4 inches. The tuning condenser has a maximum capacity of 35 μμfd., and a spac-

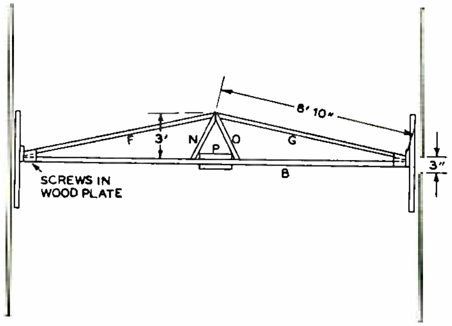

Figure 4.
LOOKING AT THE ARRAY HEAD-ON.

ing depending on the power used. The voltage across the condenser will not be particularly high even with high power.

Adjustment of the Antenna

All the elements should be set at approximate values given in figure 1, the deltas set at a span of approximately 40″, and the concentric cable to shunt about two turns of the coil. A indicates a radiator, D_1 and D_2 the first and second directors respectively and R a reflector. Again referring to figure 1, the D_1's should be adjusted first, with all other elements except the antennas open at the center, for maximum front gain as indicated by a good field strength meter or a receiver. The

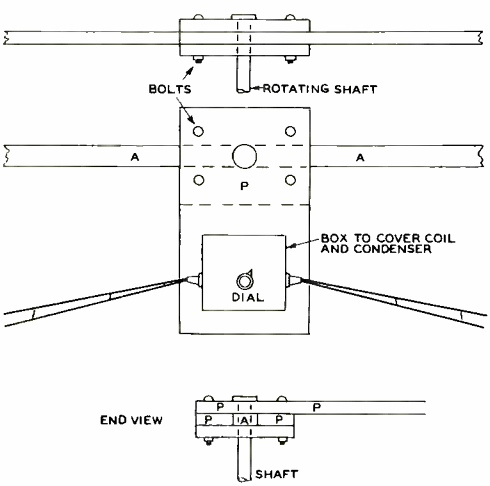

Figure 5.
ILLUSTRATING DETAIL.

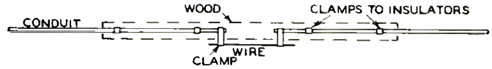

Figure 6.
METHOD OF PERMITTING ADJUSTMENT OF ELEMENT LENGTH.

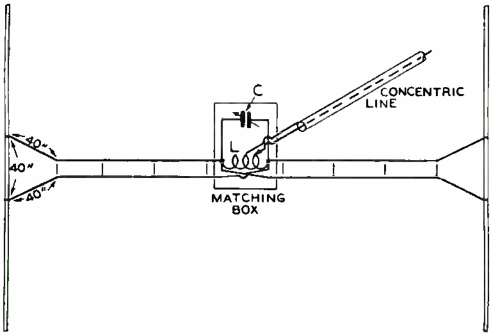

Figure 7.
FEED SYSTEM.

antenna used to receive energy to tune the beam should be polarized the same as the beam, or in this case vertical. Next the D_2's should be tuned for maximum gain with the R's open; and finally the R's should be tuned for the minimum back radiation as shown by a minimum reading on the tuning indicator with the beam now rotated through 180° so that the reflectors are nearest the indicator. There will be some interlock in the tuning of the elements, but if this procedure is repeated several times including the adjusting the A's

[*Continued on Page* 76]

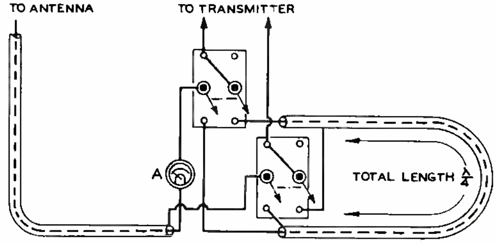

Figure 8.
METHOD OF INSERTING EXTRA ¼ WAVE SECTION OF LINE TO CHECK FOR PRESENCE OF STANDING WAVES.
With both switches in the down position, the extra line is inserted; with both switches up it is shorted out.

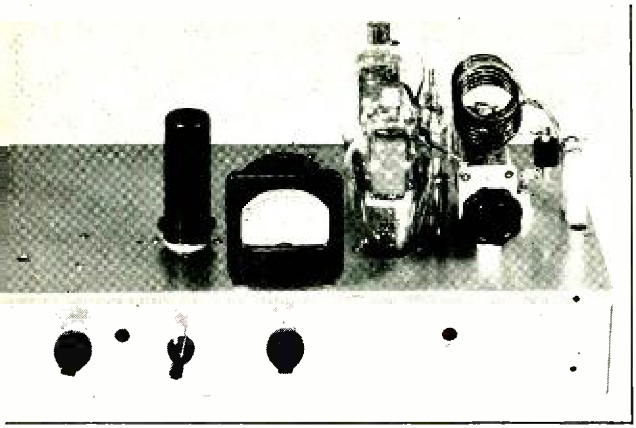

Figure 1.
175 WATTS OUTPUT ON 28 MC. WITH INEXPENSIVE PARTS.

This r.f. unit, designed expressly for one band operation, combines high efficiency with low cost. A pair of 812's are run at 1000 volts and 250 ma.

A MEDIUM-POWER TRANSMITTER

• For the 28 Mc. "Squatter"

By JACK H. ROTHMAN,* W6KFQ

The holder of a class B ticket who finds the problem of b.c.l. interference just too much to cope with on 160-meter phone will find this "strictly 10 meter" r.f. unit hard to beat for simplicity and economy.

The phone man who doesn't have a class A ticket has little choice of bands when his neighborhood is so infested with $9.95 superhets that a fling on 160 is tantamount to hara-kiri. If he is interested in local rag chews he rigs up an HY-75 on 2½ meters and avoids the wrath of the neighbors.

That leaves 10 meters for dx. And if the transmitter is going to be fixed permanently on that band, the r.f. section might just as well be designed for maximum performance at minimum cost for one-band operation. Such a unit is illustrated in figures 1, 2 and 3. Designed for use with a combined v.f.o.-exciter such as the Meissner "Signal Shifter" or other such unit capable of delivering at least 4 or 5 watts on 20 meters, the "strictly 10 meter" unit employs a 6L6 tetrode connected frequency doubler to drive a pair of GL812's to 250 watts input (or less if desired). At full input the carrier power is in the neighborhood of 175 watts, which is pretty good "actual" efficiency for 10 meters. In a rig using a physically large tank condenser and plug in coils, the measured efficiency ordinarily will be found about 10 per cent less than this on 28 Mc. (This refers to actual carrier power, not plate input minus the estimated plate dissipation.)

The unit may be fed from any well filtered power supply delivering approximately 1000 volts under load, and modulated by a pair of 809's, HY30-Z's, TZ-20's, etc., at 800 to 900 volts.

A variation on the common method of unity coupling permits a simple and accurate balance in the grid circuit of the push-pull GL812's. While the common practice is to use a tuned primary with a closely coupled untuned secondary, in this instance the reverse is true. The 6L6 doubler is provided with a 20-meter tuned tank in its grid circuit to allow twisted pair or coaxial line feed from the v.f.o.-exciter.

A single milliammeter, 0-300 ma., is used to measure plate current to the 6L6, grid current to the 812's, and plate current to the 812's by means of a meter switch. The unit is constructed on a standard 17-inch chassis, and is so arranged that a front panel may be added if desired.

*Laboratorian, RADIO.

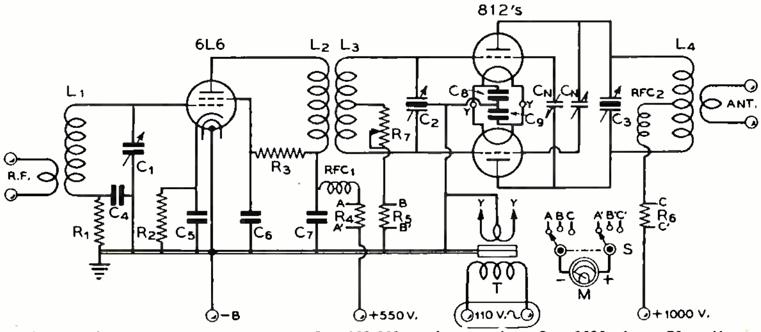

Figure 2.
SCHEMATIC WIRING DIAGRAM OF THE R.F. UNIT.

C_1—55 μμfd. midget condenser
C_2—35 μμfd. per section, split stator midget
C_3—35 μμfd. per section, split stator "semi-midget," .08 in. spacing
C_4 to C_9—.002 μfd. mica
C_n—Telescopic type neutralizing condensers
RFC_1—2.5 mh., 125 ma.
RFC_2—2.5 mh., 250 ma.
R_1—100,000 ohms, 1 watt
R_2—400 ohms, 10 watts
R_3—100,000 ohms, 2 watts
R_4, R_5, R_6—25 ohms, 1 watt
R_7—3000 ohms, 50 watts with slider.
T—6.3 volts, 10 amp.
M—300 ma. d.c.
S—Two pole meter switch, high voltage insulation

Coils

All coils are soldered permanently in the circuit. The 6L6 grid coil, L_1, consists of 18 turns of no. 22 on a 1-inch form, spaced to 1¾ inches. The link consists of two turns of hook-up wire at the "cold" end.

The interstage coils, L_2 and L_3, should really be considered as a unit. L_3 consists of 8 turns of no. 12 enamelled wire, 1⅛ inch in diameter, spaced slightly greater than the diameter of the wire, and soldered directly to the two stator lugs of C_2. L_2 consists of 4 turns of heavily insulated hook-up wire (1000-volt insulation) the same diameter as L_3, slipped down between the center turns of L_3 so as to provide very close coupling.

The final amplifier tank coil, L_4, consists of 8 turns of no. 12 enamelled, 1⅝ inch in diameter, and spaced to 2 inches. The coil is self supporting, and the lack of supporting ribs makes it possible to vary the coupling to the output link by sliding the link in and out of the coil. The link consists of 1 turn of well insulated wire, supported as illustrated in figure 1. If it is impossible to obtain sufficient coupling with one turn, the coupling link should be increased to two turns, but this should not be done unless it is impossible to obtain the desired coupling with a single turn.

The "telescopic" type neutralizing condensers permit a compact assembly and short neutralizing leads. To minimize the r.f. lead length, the two GL812's are "underslung" about 1 inch, which allows shorter plate and neutralizing leads without increasing the length of the grid leads.

The grid leak for the 812's is made adjustable, and the resistance is increased until the grid current to the final amplifier is just 50 ma. under actual operating conditions. Under these conditions the bias developed across the resistor will be more than sufficient for modulated class C operation. However, if slightly greater excitation should be desirable, it may be had by lowering the value of R_3 to 75,000 ohms.

See Buyer's Guide, page 96, for parts list.

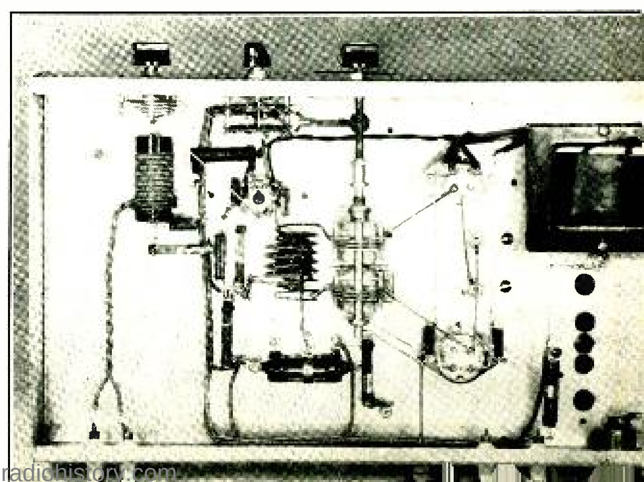

Figure 3.
UNDER CHASSIS VIEW, SHOWING RECOMMENDED LAYOUT OF PARTS.

THAT 5 *and* 10 METER SKIP

By E. H. CONKLIN, W9BNX*

After a number of pleasant winters during which the ten-meter band has produced some very luscious dx, nearly everyone is familiar with the general characteristics of winter F_2 layer skip, with contacts out to perhaps 2000 miles per hop, and multiple hop work the rule rather than the exception. Until quite recently, however, there was no general acceptance of an explanation as to how both the five- and ten-meter bands occasionally produced a few unpredictable hours of very loud signals, especially in the months of May through August.[1] Up to this time, no particularly convincing discussion has appeared in any magazine with a wide circulation among amateurs, although the U.H.F. Department of RADIO has often included comments on one or another phase of the subject.

Several years ago, Fritz Franke of Chicago said that one does not know much about skip dx, nor can he do much to predict its recurrence, until it has been determined just what layer or means of propagation caused it. Further thought on this subject indicated that he "had something there." Lately, as the conviction has grown that a "sporadic-E" layer, of very spotty nature, was the cause of it all, the writer has urged students of this condition to tend more to the use of ionosphere measurements rather than hit or miss amateur reports on which to base research work looking for a method of predicting recurrence of good u.h.f. dx conditions.

The studies that have been made of the relationship between u.h.f. skip dx and the appearance of a sporadic-E layer in ionosphere measurements are by no means widely known by the occupants of these bands. The early work which was summarized in the writer's paper in the *IRE Proceedings* last year[1] which can now be brought up to date and additional comments made, based on 1938-40 work, but it is now evident that the selection of 1937 for a complete study was a fortunate one, because of the volume of reports that would have to be rechecked in detail to apply the same procedure to the later years, in order to eliminate the misleading errors in identifying calls. A general study of the later reports has shown that the same connection still exists between amateur five- and ten-meter "summer skip" and the ionosphere records of the recurrence of the sporadic-E reflections. The following study, therefore, in general appears to hold good up to the present time.

Since the summer of 1934, amateur 56-megacycle communication has taken place with increasing regularity over distances of roughly 400 to 1250 miles. All evidence pointed to a "skip," producing a large silent zone between the stations communicating with each other, and a silent zone beyond. The zone of reception was often rather narrow, apparently 50 to 200 miles. An explanation of this type of communication was advanced by the National Bureau of Standards—that it resulted from reflections from a sporadic-E ionosphere layer, at a virtual height of around 110 to 130 kilometers. On a few occasions when a large number of long-distance reports on 56 megacycles were received, the ionosphere records of the Bureau indicated sporadic-E reflections,[2] but the data were not considered to be sufficiently extensive to confirm the explanation.

Reports of about 280 cases of 56-megacycle reception or two-way communication over a similar distance on thirty-three days during May, June, July, and August, 1937, were verified so far as possible.[3] This volume of observations gave promise of being sufficient to confirm or refute the suggested explanation. The Bureau provided hourly measurements of

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*Associate Editor, RADIO, Wheaton, Ill.

[1]E. H. Conklin, "56 Mc. Reception via Sporadic-Layer Reflections." *I.R.E. Proc.,* Jan., 1939, p. 36.

[2]E. H. Conklin, "Five meters goes to town," RADIO, no. 221, p. 24; July, (1937).

[3]Comments including the individual reports were contained in the author's article, "56 Mc., the new DX band," RADIO, no. 222, p. 66, October, (1937), except for the August 16 and 18 reports which will be found in the November issue.

Table I

Daily 56-Mc Reception Index	Daily Total of Hourly Sporadic-E Indexes					
	0	1-2	3-4	5-6	7-8	over 8
	Number of days					
0	32	24	13	7	2	3
1	1	1	1	—	1	4
2	1	—	2	3	—	—
3	—	1	—	—	—	1
4	—	1	1	4	1	3
Ratio of Days of Reception to Total Days (%)	5.9	11.1	23.5	50.0	50.0	72.8

the incident critical frequency of the E layer over the four-month period, so that the correlation might be studied.

Limitations of the Data

The Bureau makes automatic records of signals returning vertically from the ionosphere, indicating the height of the layers and the maximum frequency which will be returned. The automatic data during the summer of 1937, however, extended only to 6200 kilocycles. The sporadic-E data obtained by these measurements were grouped and tabulated in the form of an index, the numeral 1 indicating sporadic reflections above 4.4 megacycles but not above 6.2 megacycles, and 2 indicating reflections at 6.2 megacycles and over. Once each week, extended runs were made manually at higher frequencies; when this was done, additional indexes are available—3 indicating reflections above 9 megacycles but not above 12 megacycles; and 4, reflections above 12 megacycles. When these manual observations were lacking, any index 2 may have been a 3 or 4.

On some days or hours, the data are missing. When observations are not available for the hours near the time of a case of 56-megacycle reception, the report cannot be used. Between midnight and at least 10 A.M., few amateurs are operating on this band, so the absence of reports may not indicate that 56-megacycle communication was impossible, inas much as all data may not have reached us, and stations are not always in operation at the correct distances and times.

Daily Relationship

The number of 56-megacycle reception reports in a single day have been assigned index numbers for convenience. The number 1 indicates a single report; 2, either two or three reports; 3, four or five reports; while 4 is used where more than five reports have been received.

Table I shows a tabulation of the number of days on which occurred both the daily 56-megacycle reception indexes indicated in the left-hand column and the sporadic-E indexes indicated by the top line of numbers. At the bottom is entered the rising percentage of days on which reception was reported with days of increasing totals for the hourly sporadic-E index. This shows that 56-megacycle communication was more probable on days of higher sporadic-E index totals. No account has been taken of the fact that the high total might have resulted from a large number of hours of low indexes, or a few hours of high indexes.

Hourly Data

Unlike a comparison between sunspots and radio, the relationship between sporadic-E-layer reflections and 56-megacycle communication over a distance of 400-1250 miles becomes much more apparent as the data for a shorter period of time are compared.

In figure 1 are plotted the hourly indexes provided by the Bureau, for all days on which extended manual observations were made, during the four months, except the ten Wednesdays on which no signals were heard and almost no sporadic-E-layer reflections were recorded at Washington. The indexes 3 and 4, therefore, appear here. The dashed line indicates the hourly number of 56-megacycle reports, using hourly index numbers similar to the daily indexes mentioned above. The major peaks on the evening of May 14 show a remarkable similarity between the sporadic-E-layer reflections observed in Washington, and 56-megacycle communication between the midwest and New England.

On July 14, there is another marked similarity. Although most of the reports were those of a Dallas station in communication

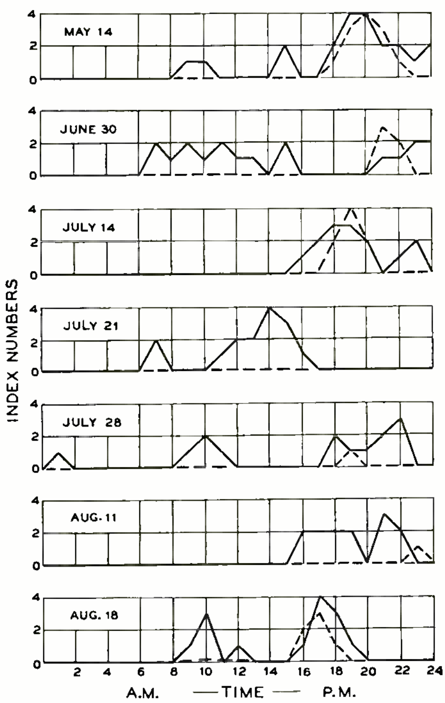


Figure 1. Hourly comparisons of sporadic-E-layer reflections observed at Washington (solid lines) with long-distance 56-megacycle reception (dashed lines) for days on which extended manual observations were made, using index numbers explained in text.

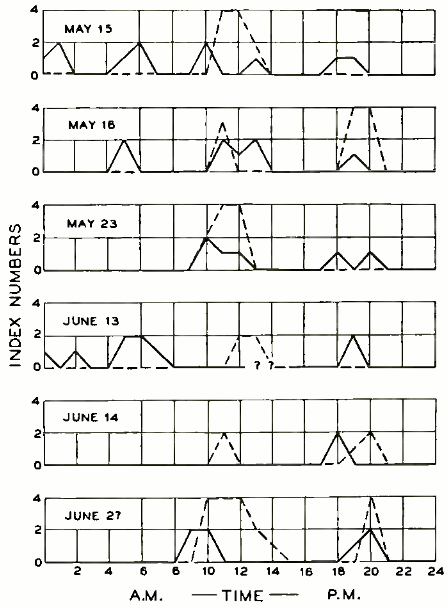


Figure 2. Hourly comparisons of sporadic-E-layer reflections observed at Washington (solid lines) with long-distance 56-megacycle reception (dashed lines), May 15 through June 27, 1937, for days of automatic observations only.

with amateurs in the east-north-central states, there was also transmission between the midwest and the east, and between Wyoming and Oregon, all plotted in terms of local standard time.

July 21 was one of the best days of the year for sporadic-E-layer reflections, but no reports of long distance 56-megacycle transmission have been received. One explanation is that there may not have been amateur stations active on 56 megacycles at the proper distances on this Wednesday afternoon.

The data for July 28 and August 18 are similar to that for May 14 and July 14. August 11 includes a single report over a relatively short path of 320 miles—Fort Thomas, Kentucky, to Beloit, Wisconsin—and is so much shorter than the next nearest distance that it has not definitely been attributed to ionosphere transmission.

In figures 2 and 3, the data have also been plotted for the balance of the days on which two or more cases of 56-megacycle reception were reported. These also in most cases indicate some association between the series, which is particularly striking on the evening of July 19 when the lines are identical, and on May 16 and June 27 when reception was recorded twice during the day, each time being nearly identical with high levels for the ionosphere index. On the morning of June 27, one station in Dallas, W5EHM, established two-way communication with 22 amateurs in New York, Pennsylvania, and the east-north-central states, reporting that 50 or 75 signals were audible.

The early peak on June 14, not accompanied by sporadic-E reflections observed at Washington, represents reports from Ohio and Pennsylvania of the signals of W5EHM in Dallas. This is the most severe case of a lack of correlation, but covers a path centered somewhat west of Washington where conditions could have been different.

In six out of the seven remaining days—those for which only one report was received—there were sporadic-E reflections at the same time or within one hour. On the seventh the path was between Texas and Arizona, far west of Washington; and there remains some

Table II

	May	June	July	August	Total
No. hours E_s observed	51	57	69	51	228
No. hours E_s not observed	260	334	216	362	1172
% E_s observed	16.4	14.6	24.2	12.3	16.3
No. hours reception coincided with E_s	12	6	9	8	35
No. hours reception within an hour of E_s	3	2	1	3	9
No. hours reception with no E_s within an hour	1	5	0	0	6
% reception coinciding with E_s	75.0	46.2	90.0	72.7	70.0
% reception coinciding with or within one hour of E_s	93.7	61.6	100.0	100.0	88.0

confusion as to the exact date on which it took place.

Table II summarizes the sporadic-E (E_s) and 56-megacycle reception data by months during the summer of 1937 and shows the increased probability of 56-megacycle reception at dictances between 400 and 1250 miles when sporadic ionization occurs over when it does not occur.

The data by months are on an hourly basis, showing the percentage of hours on which sporadic-E reflections were observed at Washington, and during which 56-megacycle reception coincided with the sporadic condition or took place within one hour of such sporadic ionization. The five hours in June when the 56-megacycle reception was not within an hour of observation of sporadic reflections include one hour when no ionosphere observations were made, and four hours when the mid-points of the transmission paths were considerably west of Washington. It is seen that reception was generally much more likely to coincide with sporadic ionization than it was to occur when such ionization was absent.

It has also been possible to study the effect of stronger ionization as indicated by E-layer reflections at higher frequencies by using only the days on which manual measurements were made. It happens that sporadic ionization was observed during every hour that 56-megacycle reception was reported on these days except for the 320-mile report on August 11 which has not definitely been attributed to ionosphere transmission. It was found that 56-megacycle communication was about 20 times more probable when the ionization indexes 3 or 4 appear, than when indexes 1 or 2 were reported. Also, 56-megacycle transmission was 48 times more probable when one of the two higher indexes was recorded within one hour. These high figures for the likelihood that long-distance transmission will coincide with strong sporadic ionization appear even though the two higher indexes were reported during only 4.6 per cent of the hours of manual observations.

Figures 1, 2 and 3 serve to indicate the duration of periods of reception, which varied from a few minutes in some cases, to several hours in others. When the period is longer, a greater number of reception reports is almost invariably received.

Distance Versus Layer Height

The longest distance in the U.S. over which 56-megacycle signals were reported during these months was approximately 2200 miles between Jerome, Arizona, and Malden, Massachusetts, on May 14 when at the same time numerous Massachusetts and mid-western stations were able to establish two-way contacts. The Arizona station was unable to identify six other signals due to severe fading. Because of the 600- to 900-mile communication taking place at the eastern end of the Arizona-Massachusetts path and the severe fading, these signals were considered to have arrived by two hops averaging 1100 miles each.

The second longest reception was on July 20 and 27 when W2XCH in New York on 53 megacycles was reported in Dallas. This distance is about 1365 miles as calculated for a great-circle path. However, the longest reasonably stable reception for an amateur transmission was 1214 miles between Dallas and North Tonawanda, New York. There were numerous reports of reception and two-way communication somewhat under 1200 miles, as shown in figure 4 which summarizes all the data by transmission range except for the 2200-mile reception discussed above.

It is possible to calculate maximum distances for transmission via a single reflection at the virtual height of the E layer. This has

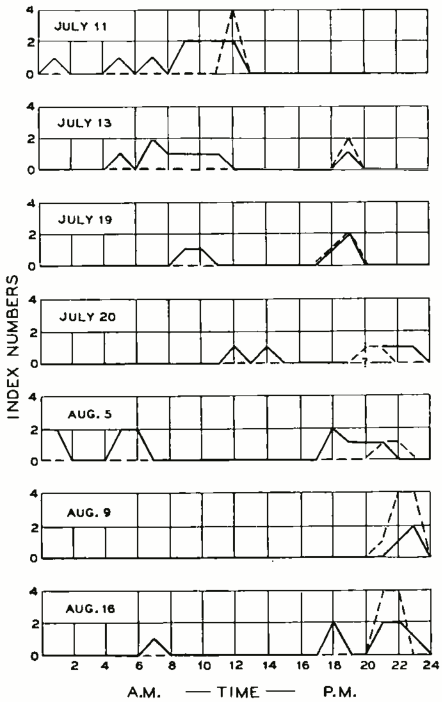


Figure 3. Hourly comparisons of sporadic-E-layer reflections observed at Washington (solid lines) with long-distance 56-megacycle reception (dashed lines), July 11 through August 16, 1937, for days of automatic observations only.

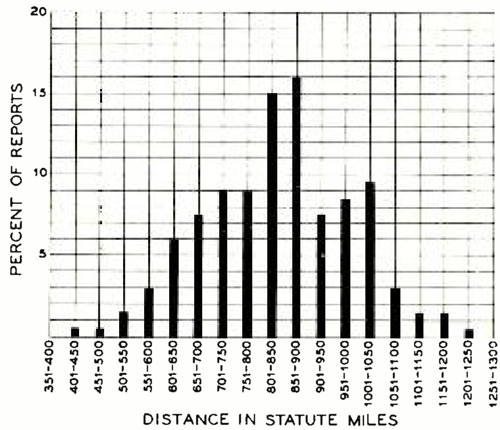


Figure 4. The distribution of 56-megacycle reception reports during the summer of 1937 by transmission range.

Table III

Layer Height (kilometers)	Maximum Distance (statute miles)
100	1041
110	1105
120	1165
130	1225

been done for several heights in Table III, assuming that signals within 3 degrees of being tangent to the earth are largely cancelled due to ground-reflection effects. It will be recognized that a normal value of 120 kilometers very nearly coincides with the maximum of about 1200 miles mentioned above. High power, or unusual transmission conditions, can readily permit some variation in the assumed 3-degree limit,[4] explaining all except the one 2200-mile case which is considered to have been two-hop.

The shortest distance represented is 320 miles from Fort Thomas, Kentucky, to Beloit, Wisconsin, on August 11. This is an unconfirmed report. The signal may not have traveled via an ionosphere reflection. It is an isolated case, the next nearest being 430 miles between Ambridge, Pennsylvania, and Elgin, Illinois. A number of signals were heard at distances somewhat greater than this. The range of distances which we have attributed to this mode of transmission, therefore, is approximately 400 to 1250 miles with occasional cases extending another 300 miles.

More Recent Experiences

The continued activity on five meters and the additional dx that has resulted has added something to our knowledge of this useful "freak" method of obtaining skip dx on very high frequencies.

Amateur reports on one excellent "wide-open" day, June 5, 1938, were charted[5] in much the same manner as figure 4. Through the co-operation of the late Ross Hull, all reports beyond 1250 miles were investigated, and all were traced to improper identity of a similar call within 1200 miles that was actually on the band at the time. Thus, it was possible to eliminate the "hump" in the curve summarizing the distance covered by the days reports, resulting in much the same pattern as figure 4, and differing mainly in the greater number of contacts at 700 miles which were

[*Continued on Page 74*]

[4]Potter and Friis, "Some effects of topography and ground on short-wave reception," *Proc. I.R.E.*, vol. 20, pp. 699-721; April, (1932).

[5]J. A. Pierce, "Interpreting 1938's 56-Mc. Dx." *QST*, September, 1938, p. 23.

NEW TUBES

RCA Issues Operating Data on Five New Transmitting Tubes

Complete operating information on four new u.h.f. transmitting tubes and an improved rectifier has recently been released by RCA. Three of the new tubes, the 815 dual beam-power amplifier (a 2½-meter FM transmitter designed around this tube is shown in the 1941 RADIO HANDBOOK, the 826 u.h.f. triode with 60 watts plate dissipation, and the greatly improved 866-A/866 will be of particular interest to amateurs. The other two, the 1625 beam-power amplifier (an 807 with a 12.6-volt heater), and the 1626 triode (5 watts plate dissipation and 12.6-volt heater) are particularly designed for aircraft service and will be of particular interest to the designers of this type of equipment.

THE 815 DUAL BEAM TETRODE

The 815 is a new push-pull beam power amplifier designed for radio amateur use at ultra-high frequencies. Its exceptional efficiency and high power sensitivity permit full power input with very low driving power. A single 815 operated in push-pull class C telegraph service is capable of handling a power input of 75 watts with less than ¼ watt of driving power at frequencies in the 112-Mc. band. The total maximum plate dissipation of the 815 is 25 watts. The 815 is also useful as a modulator and as a multiplier. A single 815 can modulate another 815 as power amplifier. In multiplier service, the 815 can be used as a doubler or tripler and at the same time drive an 815 as power amplifier. Mechanical features of the 815 include its balanced and compact structure of beam units, close electrode spacing, short internal leads to minimize lead inductance and resistance, and a "Micanol" wafer octal base. The heaters of the 815 are arranged for either 12.6- or 6.3-volt operation.

This tube has been brought out to fill a need for an inexpensive push-pull u.h.f. beam tetrode for amateur use. It is quite similar in operating characteristics to the 829 and 832, and sells for about one fourth the price of these two tubes. It is particularly suitable for operation in the 112-Mc. band, being rated for full operation at frequencies as high as 150 Mc., and can be used in the 225-Mc. band at 70 to 75 per cent of the full ratings.

TENTATIVE CHARACTERISTICS AND RATINGS

HEATER (A.C. or D.C.)	
Voltage per unit	6.3 volts
Current per unit	0.8 ampere
TRANSCONDUCTANCE, for plate current of 25 ma.	4000 micromhos
GRID-SCREEN MU-FACTOR	6.5
DIRECT INTERELECTRODE CAPACITANCES (Each unit)	
Grid-Plate (with external shielding)	0.2 *max.* μμfd.
Input	13.3 μμfd.
Output	8.5 μμfd.
BULB	T-16
BASE (With "micanol" wafer)	Large wafer octal 8-pin, sleeve
CAPS (Two)	Small metal

MAXIMUM CCS and ICAS RATINGS with TYPICAL OPERATING CONDITIONS

CCS = Continuous Commercial Service
ICAS = Intermittent Commercial and Amateur Service

As Push-Pull A. F. Amplifier and Modulator—Class AB_2

	CCS	*ICAS*	
D.C. Plate Voltage	400 *max.*	500 *max.*	volts
D.C. Screen Voltage (Grid No. 2)	200 *max.*	200 *max.*	volts
Max.-Signal D.C. Plate Current	150 *max.*	150 *max.*	milliamperes
Max.-Signal Plate Input	60 *max.*	75 *max.*	watts
Max.-Signal Screen Input	4 *max.*	4 *max.*	watts
Plate Dissipation	20 *max.*	25 *max.*	watts

Typical operation:			
D.C. Plate Voltage	400	500	volts
D.C. Screen Voltage	125	125	volts
D.C. Grid Voltage (Grid No. 1)	-15	-15	volts
Peak A-F Grid-to-Grid Voltage	60	60	volts
Zero-Signal D.C. Plate Current	20	22	milliamperes
Max.-Signal D.C. Plate Current	150	150	milliamperes
Max.-Signal D.C. Screen Current	32	32	milliamperes
Load Resistance (Per Plate)	1550	2000	ohms
Effective Load Resistance (Plate-to-Plate)	6200	8000	ohms
Max.-Signal Driving Power (Approx.)*	0.36	0.36	watt
Max.-Signal Power Output (Approx.)	42	54	watts

As Plate-Modulated Push-Pull R-F Power Amplifier
Class C Telephony

Carrier conditions per tube for use with a max. modulation factor of 1.0

	CCS	ICAS	
D.C. Plate Voltage	325 *max.*	400 *max.*	volts
D.C. Screen Voltage (Grid No. 2)	200 *max.*	200 *max.*	volts
D.C. Grid Voltage (Grid No. 1)	-175 *max.*	-175 *max.*	volts
D.C. Plate Current	125 *max.*	150 *max.*	milliamperes
D.C. Grid Current	6 *max.*	6 *max.*	milliamperes
Plate Input	40 *max.*	60 *max.*	watts
Screen Input	2.7 *max.*	2.7 *max.*	watts
Plate Dissipation	13.5 *max.*	20 *max.*	watts
Typical Operation:			
D.C. Plate Voltage	325	400	volts
D.C. Screen Voltage ‡			
From a fixed supply of	165	175	volts
From a series resistor of	10000	15000	ohms
D.C. Grid Voltage of	-45	-45	volts
*From a grid resistor of***	11250	15000	ohms
Peak R.F. Grid Voltage	56	58	volts
D.C. Plate Current	123	150	milliamperes
D.C. Screen Current	16	15	milliamperes
D.C. Grid Current (Approx.)	4	3	milliamperes
Driving Power (Approx.)	0.2	0.16	watt
Power Output (Approx.)	30	45	watts

As Push-Pull R-F Power Amplifier and Oscillator—Class C Telegraphy

Key-down conditions per tube without modulation##

	CCS	ICAS	
D.C. Plate Voltage	400 *max.*	500 *max.*	volts
D.C. Screen Voltage (Grid No. 2)	200 *max.*	200 *max.*	volts
D.C. Grid Voltage (Grid No. 1)	-175 *max.*	-175 *max.*	volts
D.C. Plate Current	150 *max.*	150 *max.*	milliamperes
D.C. Grid Current	6 *max.*	6 *max.*	milliamperes
Plate Input	60 *max.*	75 *max.*	watts
Screen Input	4 *max.*	4 *max.*	watts
Plate Dissipation	20 *max.*	25 *max.*	watts
Typical Operation:			
D.C. Plate Voltage	400	500	volts
D.C. Screen Voltage			
From a fixed supply of	145	200	volts
From a series resistor of	15000	17500	ohms
D.C. Grid Voltage			
From a fixed supply of	-45	-45	volts
From a Cathode resistor of	260	265	ohms
*From a grid resistor of***	10000	13000	ohms

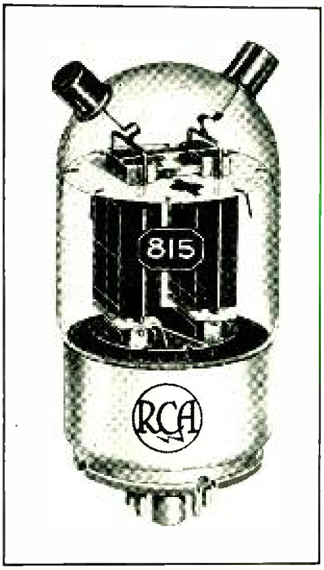
Peak r.f. Grid Voltage	58	56	volts
D.C. Plate Current	150	150	milliamperes
D.C. Screen Current	17	17	milliamperes
D.C. Grid Current (Approx.)	4.5	3.5	milliamperes
Driving Power (Approx.)	0.23	0.18	watt
Power Output (Approx.)	44	56	watts

##Modulation essentially negative may be used if the positive peak of the audio-frequency envelope does not exceed 115% of the carrier conditions.

Fixed supply, modulated simultaneously with the plate supply, is recommended. Series resistor connected to *modulated* plate-voltage supply may also be used.

** The grid-circuit resistance should never exceed 15000 ohms (total) per tube, or 30000 ohms per unit. If additional bias is necessary, a cathode resistor or a fixed supply should be used.

* Driver stage should be capable of supplying the grids of the class AB_2 stage with the specified driving power at low distortion. The effective resistance per grid circuit of the class AB_2 stage should be kept below 500 ohms and the effective impedance at the highest desired response frequency should not exceed 700 ohms.



THE 826 U.H.F. TRIODE

The 826 transmitting triode has been designed especially for use at ultra-high frequencies. It may be used as an oscillator, r.f. power amplifier, and frequency multiplier at maximum ratings at frequencies as high as 250 megacycles and at reduced ratings at frequencies as high as 300 megacycles. Maximum plate dissipation of the 826 is 60 watts in class C telegraph service. The 826 features a double-helical filament center-tapped within the tube so that effects of filament inductance can be minimized. In addition, two short, heavy leads are brought out from the grid and from the plate to individual terminals in order to reduce the inductance of these internal connections. All terminals are placed at one end of the bulb so that short leads can be used in neutralizing circuits. The tube utilizes the same socket as the 829 and 832 push-pull beam tetrodes.

TENTATIVE CHARACTERISTICS and RATINGS

Filament Voltage (a.c. or d.c.)	7.5	volts
Filament Current	4	amperes
Amplification Factor	31	
Direct Interelectrode Capacitances:		
Grid-Plate	2.9	$\mu\mu$fd.
Grid-Filament	3.7	$\mu\mu$fd.
Plate-Filament	1.4	$\mu\mu$fd.
Bulb		T-16
Terminal Mounting		RCA type UT-106
Type of Cooling		Forced Air

As Plate Modulated R.F. Power Amplifier—Class C Telephony

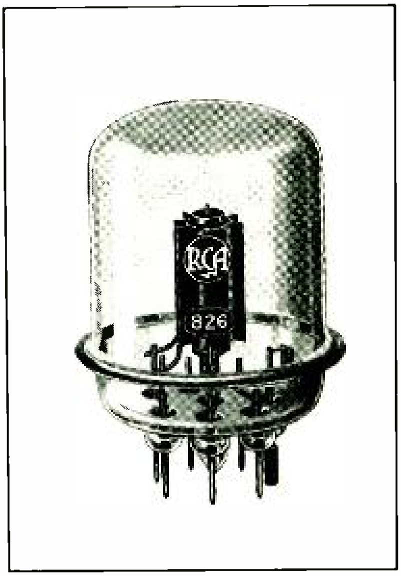
Carrier conditions for use with a maximum modulation factor of 1.0

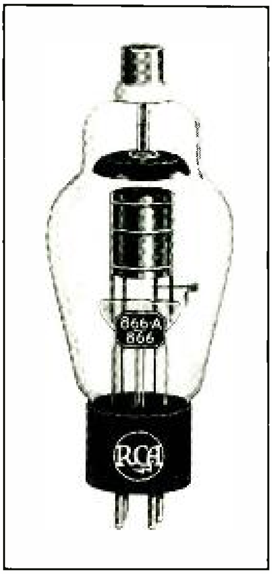
	CCS
D.C. Plate Voltage	800 max. volts
D.C. Grid Voltage	-500 max. volts
D.C. Plate Current	95 max. ma.
D.C. Grid Current	40 max. ma.
Plate Input	75 max. watts
Plate dissipation	40 max. watts
Typical Operation	
D.C. Plate Voltage	800 volts
D.C. Grid Voltage	-98 volts
From a grid resistor of	2800 ohms
Peak R.F. Grid Voltage	198 volts
D.C. Plate Current	94 ma.
D.C. Grid Current	35 ma.
Driving Power (approx.)**	6.2 watts
Power Output (approx.)	53 watts

As R.F. Power Amplifier and Oscillator—Class C Telegraphy

Key-down conditions per tube without modulation##

	CCS
D.C. Plate Voltage	1000 max. volts
D.C. Grid Voltage	-500 max. volts
D.C. Plate Current	125 max. milliamperes





D.C. Grid Current......	35	max.	milliamperes
Plate Input..................	125	max.	watts
Plate Dissipation........	60	max.	watts
Typical Operation:			
D.C. Plate Voltage	1000		volts
D.C. Grid Voltage #			
From a fixed supply of..............	-70		volts
From a grid resistor of..........	2000		ohms
From a cathode resistor of........	440		ohms
Peak R.F. Grid Voltage	183		volts
D.C. Plate Current	125		milliamperes
D.C. Grid Current (Approx.)**	35		milliamperes
Driving Power (Approx.)**	5.8		watts
Power Output (Approx.)	86		watts

\# Grid voltages are given with respect to the mid-point of filament operated on a.c. If d.c. is used, each stated value of grid voltage should be decreased by one-half the filament voltage and the circuit returns made to the negative end of the filament.

\#\#Modulation essentially negative may be used if the positive peak of the audio-frequency envelope does not exceed 115% of the carrier conditions.

** Subject to wide variations depending on the impedance of the load circuit. High-impedance load circuits require more grid current and driving power to obtain the desired output. Low-impedance circuits need less grid current and driving power, but plate-circuit efficiency is sacrificed. The driving stage should have a tank circuit of good regulation and should be capable of delivering considerably more than the required driving power.

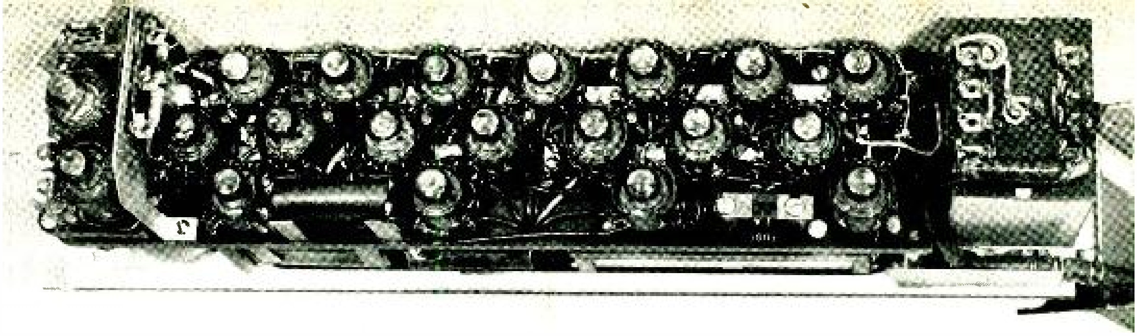
THE 866-A/866 MERCURY-VAPOR RECTIFIER

The 866-A/866 is a new half-wave, mercury-vapor rectifier to supersede the well-known RCA types 866-A and 866. This new tube combines the ability of the 866-A to withstand high peak inverse voltage and the ability of the 866 to conduct at relatively low applied voltage. The 866-A/866 employs a ceramic cap insulator and is constructed in a dome-top bulb. This construction minimizes danger of bulb cracks caused by corona discharge. An edgewise wound ribbon filament made of a new alloy material provides a large emission reserve and improved life. Two 866-A/866's operating in a full-wave rectifier are capable of delivering to the input of a choke-input filter a rectified voltage of 3180 volts at 0.5 ampere with good regulation. The maximum peak inverse voltage on the new tube is 10,000 volts, and the maximum peak plate current is 1.0 ampere. The rated average plate current in a conventional power supply is 250 ma. per tube.

THE 1625 BEAM POWER AMPLIFIER

The 1625 transmitting beam power amplifier is similar to RCA-807 but it has a 12.6-volt heater and a 7-pin base. Because of these features, the 1625 is particularly suitable for use in aircraft radio transmitters. In these transmitters and other equipment subject to vibration and shock, the 7-pin base provides

[*Continued on Page 73*]



● It takes 20 acorn triodes to operate this RCA neon-tube volume indicator. Thirteen of the acorns are connected to small neon tubes which flash on to indicate any audio level from minus 45 to plus 3 decibels across the line being monitored.

DEPARTMENTS

- **X-DX**
- **With the Experimenter**
- **U. H. F.**
- **The Amateur Newcomer**
- **Yarn of the Month**
- **What's New in Radio**
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- **New Books and Catalogs**

"WAZ" HONOR ROLL

CW and PHONE

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J5CC	40	130
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W2GTZ	39	153
W2HHF	39	152
G6WY	39	151
W6GRL	39	151
W6CXW	39	150
W2GT	39	150
W9TJ	39	149
W4CBY	39	145
W6CUH	39	143
W6KIP	39	143
W8OSL	39	143
W9KG	39	141
W6ADP	39	140
W6BAX	39	140
W3AG	39	140
W8OQF	39	139
W8LEC	39	136
W6QD	39	135
W9TB	39	134
W2ZA	39	134
VK2EO	39	133
G5BD	39	133
W2GVZ	39	132
W4CYU	39	132
W3EVT	39	131
W8PQQ	39	131
W5KC	39	130
W2GWE	39	129
W6KRI	39	129
W1ADM	39	128
VE4RO	39	126
W6VB	39	125
W7BB	39	123
W6HX	39	123
G5BJ	39	120
W8JSU	39	120
W2IYO	39	119
W2CYS	39	117
G2LB	39	115
W4IO	39	115
W7DL	39	115
W38EN	39	115
W2GNQ	39	113
W6FZL	39	112
ON4HS	39	111
ON4FE	39	110
W1AQT	39	110
W6FZY	39	109
W6SN	39	100
W9NRB	39	98
W6GPB	39	94
XE1BT	39	90
K6AKP	39	78
W1CH	38	150
W2GW	38	143
W5VV	38	144
W3HZH	38	139
W3EMM	38	139
W5BB	38	138
W8BKP	38	138
ZL1HY	38	138
W3EPV	38	136
W9GDH	38	134
W3HXP	38	133
W4FVR	38	130
W9FS	38	130
W3EAV	38	130
W8JMP	38	127
W2GRG	38	127
ON4EY	38	126
W8ZY	38	125
W3GAU	38	125
W1BXC	38	125
W3EVW	38	124
W3GHD	38	121
W8AU	38	120
W8LYQ	38	120
W8DFH	38	119
W9PST	38	119
W8QXT	38	119
W8JIN	38	119
W3FQP	38	119
W8DWV	38	118
W1GDY	38	118

W2BMX	38	118
W1BGC	38	117
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W9ELX	38	116
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W8EUY	38	112
W9CWW	38	112
W2BXA	38	111
W6GRX	38	111
LY1J	38	110
W1AB	38	110
W6HZT	38	110
W4MR	38	108
W8KWI	38	108
W8BOX	38	106
W9ADN	38	106
W8OE	38	106
W6NLZ	38	106
W9PK	38	105
W8GBF	38	105
W3KT	38	105
ON4UU	38	104
G2IO	38	103
W8BWB	38	98
J2KG	38	95
G6XL	38	95
ON4FQ	38	92
W9VDQ	38	79
SU1WM	37	138
W2BJ	37	134
W6GAL	37	131
W8KKG	37	127
W7AMX	37	125
J2JJ	37	123
W2IOP	37	122
W1RY	37	120
W6MVK	37	118
G6NF	37	115
W9RCQ	37	114
W3TR	37	113
ON4FT	37	112
W9RBI	37	112
W6MEK	37	112
W6ADT	37	111
W1IED	37	111
G2MI	37	110
W7AYO	37	110
W8DOD	37	110
W6ITH	37	109
VE2EE	37	108
W4DMB	37	108
W5ENE	37	107
W9PTC	37	103
W3FJU	37	103
W9GBJ	37	103
G6GH	37	102
W3AYS	37	102
VK2DA	37	101
W6FKZ	37	101
W6JBO	37	101
W8KPB	37	100
W4DMB	37	100
W9AJA	37	99
W4EQK	37	99
ON4VU	37	99
W3RT	37	99
W3EXB	37	98
ZL2CI	37	97
W6DLY	37	97
W6MHH	37	95
W6MCG	37	92
G2UX	37	91
W2BSR	37	90
W6MUS	37	89
W9UBB	37	77
W8AQT	36	120
K4FCV	36	112
W8AAJ	36	107
W3GGE	36	106
W6BAM	36	106
W9AFN	36	105
W5PJ	36	105
W8QDU	36	105
W5ASG	36	104
SP1AR	36	103

W8LDR	36	101
W6NNR	36	100
W6KWA	36	99
W8LZK	36	99
G6BJ	36	99
VE1DR	36	98
W9VES	36	98
W9GKS	36	97
W8AAT	36	96
G6YR	36	94
W2IZO	36	94
VE5AAD	36	92
W4ADA	36	90
W1APU	36	91
W9LBB	36	90
W8JAH	36	89
OK2HX	36	86
VK2NS	36	84
W6TI	36	80
W7DSZ	36	73
W2GXH	36	71
W1WV	35	119
W8OXO	35	113
W6GHU	35	103
W4QN	35	103
W9PGS	35	103
W6HJT	35	103
W9VKF	39	101
K6NYD	35	100
W8CLM	35	99
W8OUK	35	99
W8CJJ	35	98
W2WC	35	98
OK1AW	35	96
W9EF	35	94
G6QX	35	94
W8NV	35	94
W3DRD	35	93
W6AQJ	35	92
VE5ZM	35	92
W6ONQ	35	92
LU3DH	35	89
W9GNU	35	88
W9ERU	35	88
K6CGK	35	88
W9VDX	35	86
W6KQK	35	85
ON4NC	35	82
GI6TK	35	80
W4ELQ	35	80
W8QIZ	35	78
W6GK	34	105
W6HEW	34	103
K7FST	34	102
W8CED	34	102
W8BSF	34	100
W1APA	34	98
W2BZB	34	99
VK2AS	34	94
W8HGA	34	93
W3EYY	34	91
W9MQQ	34	89
W2FLG	34	89
W6TE	34	88
G6WB	34	88
W6CVW	34	88
VK2OQ	34	87
G5VU	34	85
W9BCV	34	83
W6PNO	34	83
ZS1CN	34	82
VK2TF	34	81
W6MJR	34	81
ON4SS	34	80
W6HIP	34	76
VK2TI	34	75
W7AVL	34	75
W8JK	34	75
ZL2VM	34	72
W6LHN	34	71
VK2AGJ	34	70
VK2EG	34	70
VE5MZ	34	69
VK2VN	34	63
W9QOE	34	56
F8XT	33	112
W8ACY	33	106
W3DAJ	33	97
W6KEV	33	96
W8BWC	33	93
W6KUT	33	90
W6CEM	33	88

PHONE

W3LE	38	128
F8UE	38	103
W6OCH	36	107
W6ITH	36	103
W3FJU	36	87
VE1CR	36	81
W1ADM	35	101
W9NLP	35	95
W9TIZ	35	93
KA1ME	35	79
F8VC	35	78
W4CYU	34	100
ON4HS	34	92
W9ELX	34	92
W6EJC	34	84
W7BVO	34	80
W4DAA	34	71
W2IXY	33	105
W6NNR	33	92
GM2UU	33	84
F8XT	33	70
W3FAM	33	68
W6MLG	32	97
W8LFE	32	91
W2IKB	32	90
W4DRZ	32	89
W9BEU	32	88
W9QI	32	86
W1HKK	32	85
W8QXT	32	85
G5BY	32	85
VK4JP	32	85
W4DSY	32	84
W6OI	32	83
W9TB	32	82
W6IKQ	32	80
VE1DR	32	59
W1AKY	31	93
W3EMM	31	88
W8LAC	31	85
G6BW	31	83
G3DO	31	78
W1KJJ	31	78
W6FTU	31	77
G8MX	31	73
W8RL	31	71
W9UYB	31	71
W6AM	31	67
F8KI	31	58
W9ZTO	31	53
W4EEE	30	86
W2GW	30	86
W1JCX	30	83
W8AAJ	30	82
W2IUV	30	79
W2AOG	30	77
W9BCV	30	68
W6MZD	30	52
G6DT	29	83
W4BMR	29	80
K6NYD	29	78
CO2WM	29	78
W9RBI	29	71
W6NLS	29	64
W6GCT	29	62
W6NRW	29	60
W2DYR	28	80
W2GRG	28	74
W6PDB	28	65
W8NV	28	65
W7EKA	28	63
VE2EE	28	62
W4DRZ	28	62
W1BLO	28	62
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W2HCE	27	76
W5CXH	27	52
G5ZJ	26	77
W5ASG	26	62
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X-DX AND OVERSEAS NEWS

By Herb Becker, W6QD

Send all contributions to Radio, attention DX Editor
1300 Kenwood Road, Santa Barbara, Calif.

WAAP

No more applicants for the WAAP certificate have shown up during the past month. The four listed last month here have the limelight at the present time. Could it be that no others have been able to round up the confirmations necessary? Or . . . is it just that they don't get around to collecting their cards? We'd like to see more activity in this, and you might surprise yourself by finding all the necessary cards or other confirmations in the right hand drawer of your desk.

W6NKL left December 11th for Midway Islands. We hope he can get on the air when he arrives. He has taken a good sized rig with him, as well as one of the new NC-200 receivers. We understand ham radio is prohibited by the local authorities there at present, but there might be a ray of hope of having the ban lifted shortly. Let's hope before long we will hear KD6NKL blasting away. Bill will operate c.w. and phone. If he makes the grade over there we will give you the frequencies, etc.

More on KD4GYM

Steve Paull, KD4GYM, is leaving Swan Island in February. He believes that the new man there will take up where he leaves off as far as ham radio is concerned. The new man is taking his exam for a ham ticket, and as soon as we know more on the new setup we'll print it. At least it looks like Swan will still be on the air. Steve's partner left there Xmas for the States. His place was taken by Paul Arnerich, who is not a ham, so we cannot expect any ham QSOs from him. KD4GYM has been giving the W6s a break during the past month. Previously he had worked so many more eastern stations than those out here, he began to wonder if there were any west coast stations on the air. He asked that we spread the information around that he would work just W6s every Saturday morning between 1600 and 1700 g.m.t. Sure enough, quite a number of W6s responded and Steve will send the cards through "yours truly."

W9EIT passes along the information that W2BJ has been squeezed through the small end of the horn . . . or, in everyday lingo, he is now a married man. W2BJ says no more brass pounding until dx is back with us. That is as good an excuse as any—for the time being, anyhow. Another good c.w. man going wrong (if it really is going wrong) is W2BMX, and by the time you read this, ol' man Prose should be trying to make two live as cheaply as one, etc. W2BMX is with the FCC, and is now located in Norwood, Mass., Box 41 to be exact. His *pal,* W8AU, is also with the FCC now and can be found (sometimes) at Merrifield, Va. Lou hasn't his rig set up there as yet because they may choose to send him somewhere else quite soon.

Who's the Santa Claus?

You may recall seeing a picture of W6LS and his station in the December issue. I guess all description of his antenna went for naught, because 'twas the day before Xmas, nothing was stirrin' except a 65 m.p.h. wind . . . right in the middle of Shep's backyard. He was just telling the x.y.l. that if his 60-foot tower and rotary stood up under this it would take anything. He spoke too soon . . . the whole works crashed into the roof of his home, making it necessary to call a roofing company to patch it up to keep ol' Jupe Pluvius outside where he belongs. A guy would think a thing like this would irk the deuce out of Shep. Apparently such was not the case because bright and early Xmas day he gave me a jingle on the "landline" telling me of his plight. The odd part was he said, "Isn't this a swell Xmas present though?" I couldn't quite believe he was serious but he added, "You see, I've been wanting to put up a dual three element for some time but never could seem to find an excuse. Now it's a natural, and so I'm buying this new beam for Xmas." Guess you could call that smiling right back at trouble.

W6PMB gives forth that W6PSP is now operating at St. Thomas in the Virgin Islands, his new call being KB4HBX. His frequency is about 28725 kc. and obviously it's 10 phone. Usual time on the air is Tuesday, Thursday Saturday and Sunday between 9:30 a.m. and 12:00 noon, p.s.t.

W1AQT found his way to the key of W1AAO the other night and managed to have quite a few intelligent QSOs. This word was used with reservations, however. Speaking of AQT and a few more of that W1 gang . . . I have some nice pleasant pictures of them while at a convention or something. While I am on the subject of pictures it seems that every time I ask some of the boys on the east coast for "pix" they all suggest that I get one "if I can" of W1AQT at a DX Roundup of about a year ago. Judging from all the boys who know about this photo I halfway imagine it was great fun taking it. Don't know if W1AQT knows anything about it or not . . . BUT right here I'll let you in on something. I HAVE HAD THAT PHOTO FOR ABOUT A YEAR!!! My friends, that is what you call an ace in the hole. Watch out, Bob Powell!! It might show up in this column yet . . . but am not sure that I would the following month. Anyway, Bob, position isn't everything in life.

W8CED wants to know if we can't have a sort of Junior WAAP, because there are so many fellows who need only one possession or so for WAAP. Lee suggests that we call it WNAAP for Worked Nearly All American Possessions. Might be a good idea but would destroy the purpose of WAAP, which is designed for only those who can show proof of working all 16. It will probably remain a rather small list in comparison to the WAZ Honor Roll.

News from England

Hearing from G5SA, Dave Price-Jones, this month was a pleasant surprise. You may recall that Dave and his x.y.l. spent about a year out here and made many fine acquaintances. He arrived home shortly before the war started. Dave took back quite a lot of gear with the idea of building up a completely new station. Upon arriving in England he was taken sick and has been laid up most of the time, but now I am glad to say that he is getting better. As Dave puts it . . . "with all this gear and time on my hands I am not able to use it, but I do listen in once in a while to you boys in U.S.A." G5SA lives about 35 miles outside of London, and says the only nights they cannot sleep is when there is no gunfire in town. In other words every night they expect the same noise popping and go to sleep by it. Outside of this everything in his town is much the same as ever, but no ham radio.

A very interesting letter is here from John Clarricoats, G6CL. Jack is Sect'y of R. S. G. B. and Ed. of their T. & R. Bulletin. He gives some info on what some of the old timers in G are doing . . . Johnny Hunter, G2ZQ, now F1/Lt engaged in special radio work in England. Ham Whyte, G6WY, now F1/Lt Assistant Air Attache somewhere in Europe. Art Simons, G5BD, lost an arm in 1914-18 war but now using his head and other arm to good effect. George Brown, G5BJ, with Birmingham Police on radio work. Tommy Martin, G2LB, still in Birmingham, as far as he knows. Alfred Gay, G6NF, succeeds G6UN as Prexy of R. S. G. B. on January 1, 1941. Arthur Milne, G2MI, is still doing his best to keep his column "Month Off the Air" going in T. & R. Bulletin. Geoff Hutson, G6GH, Sgt. in R.A.F. on radio work. Reg Radford, G2IM, still with B.B.C., and itching to work dx. G6CL goes on to say that 1100 British hams have notified the R. S. G. B. that they are in active service. Latest figures show that over 60% of them are in the R.A.F. Royal Corps of Signals and Royal Navy have about 12% each. Most of the dx gang are in the R.A.F. The hams continue to meet everywhere the opportunity presents itself. During August and September meetings were held at one of the big R.A.F. schools and attendances were 60 and 80, all hams. Another series of meetings were held at one of the big army "centres" at which dozens of VEs were welcomed. Bill Wadsworth, VE5ZM, after coming over as a ranker in the R.C.A.F., is now an R.A.F. Pilot Officer.

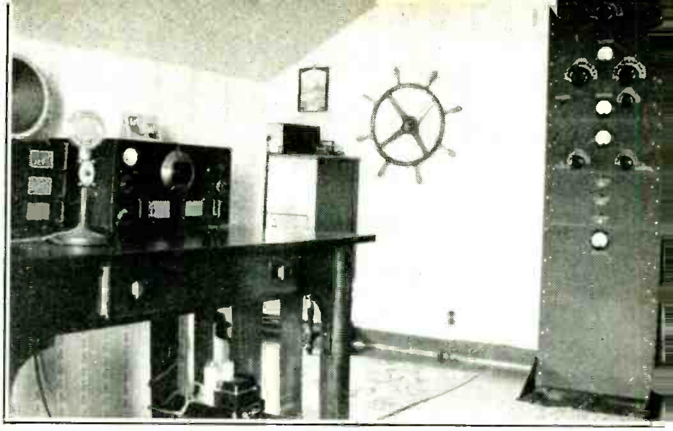
Art Simons, G5BD, writes us saying that he got a kick out of the opening paragraph of this dept. in November issue. That was the one where we printed several dx news items from RADIO of 1935, mentioning something about G5BD, W6GRX, W8CRA and a couple of other stations in a five-way QSO. Art said it surely brought back swell memories . . . and I'll say that we all agree. G5BD says he has received several QSL cards since their QRT . . . VP7NS, HC1CM, HB1CE, HR4AF, MX1A, and such a find—TS4SAX. Art says this one must have been under six layers of wallpaper, and perhaps the R.A.F. stirred it up. He also adds that if this catches the eye of VP9L or FN1C, he would like their cards. (VP9L, ditto for me, too.)

Snooping Around

Heard W2UK on high end of 20 the other p.m., so hurriedly fired up the rig and gave him a blast. The only blast I could hear came from plate transformer, letting out plumes of nice smelly smoke at the same time. Result: QD off the air. The same night W7AYO was heard pounding away as well as several other signals that made it appear something

[*Continued on Page 89*]

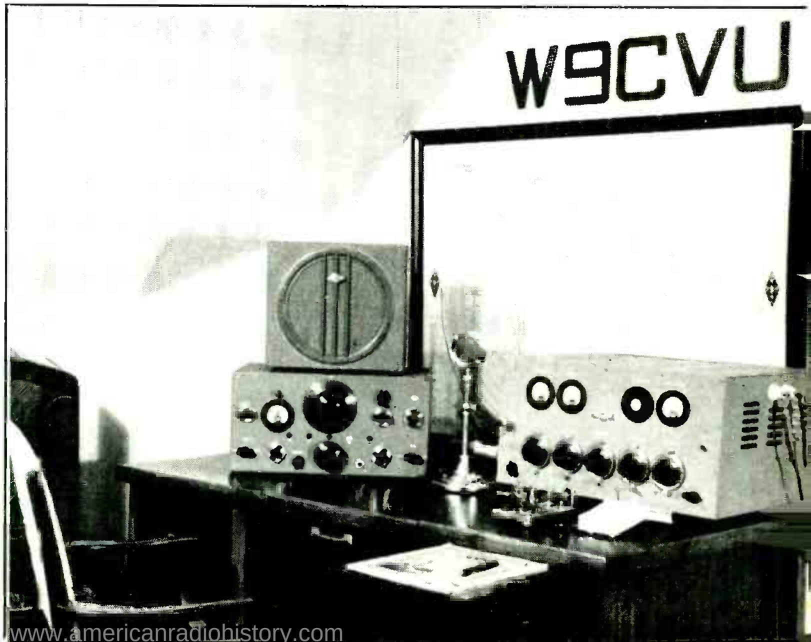
● **W5EGJ,** Perryton, Texas—Operator, H. Herbert Key. The photograph at the top of the Departments page in the December issue of RADIO showed the 2000-watt power plant used at W5EGJ, since a.c.-line power is not available. The photograph alongside shows the station for which this two-kilowatt plant supplies energy. The transmitter operates all bands, 10 to 160, with 450 watts input to a pair of T55's in the final. The speech equipment for phone is conventional and ends up in a pair of 203Z's as class B modulators. The tiller wheel on the wall controls the 10-meter three-element rotary.



Amateur Stations

● The mobile installation of **W9WZO,** Naperville, Illinois—Operator, Ralph B. Netzley. The transmitter is installed in the upper left hand corner of the luggage compartment, leaving the balance of the space free for luggage and isolating the rig from the usual jars and bumps experienced when the installation is made on the floor of the compartment. The rig is conventional, consisting of a T21 crystal oscillator and a T21 doubler with a 6N7 speech amplifier and 6N7 modulator. Plate power is supplied by two paralleled 300-volt 100-ma. vibrapacks. The transmitter is operated on the 56-Mc. band (it was operated on 28 Mc. before the ban) and on 112 Mc. with an outboard HY-75 oscillator á la W6QZA. The receiver is a one-tube converter with plug-in coils operating into the auto receiver.

● **W9CVU,** Cedar Rapids, Iowa—Operator, Chas. W. Boegel, Jr. The operator of W9CVU has the distinction of having been on the air for 26 years, and of having been the first OPS in Iowa to obtain a 30 w.p.m. certificate. The transmitter is a manufactured job with 75 watts input to a pair of 6L6's in the final and 4-6L6's as modulators. The receiver is a 101X with a noise limiter, and a D-104 crystal is used as the microphone. The antenna installation is rather extensive with a full-wave zepp, 50 feet high, on 75 meters; 7 half waves on 14 Mc. and 14 half waves on 28 Mc.



With the Experimenter

AN FM RECEIVER FOR LESS THAN FIFTEEN DOLLARS

By George W. Brooks,* WIJNO

This FM receiver began with the remains of a GE E-72 broadcast and short wave receiver that I picked up in a local radio "Shylock's" in one of my weak moments. The set consisted of a 6A8, 2-6K7's, 6H6, 6F5, and 6F6G with a 5Y3G supplying the hot stuff.

Soon after the set was home, FM began to rear its head with the construction of the Yankee Network's FM transmitter at Paxton, Massachusetts. Being interested in the claims set forth for FM, I decided that I would have to have a receiver. But sad to contemplate, all the receivers then on the market had price tags that would be equivalent to the national debt, as far as I was concerned—especially if I purchased one and the family got wind of the price I paid.

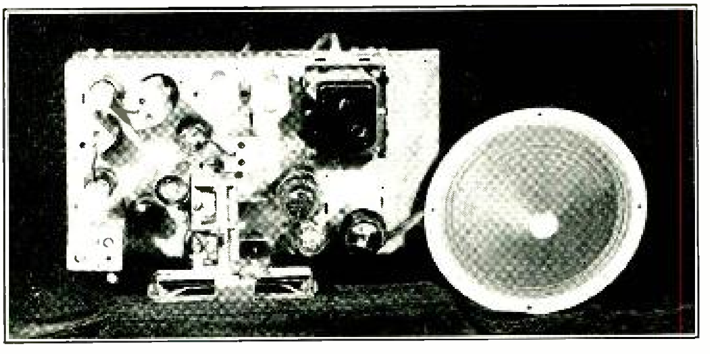
*28 Friendship Street, Newport, Rhode Island

About this time my eye fell upon the GE, and an idea was born. Why couldn't it be rebuilt for FM?

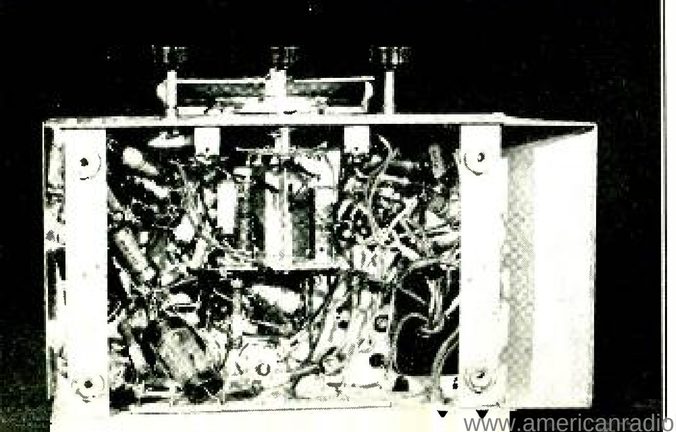
Inquiries of friends for practical information on FM gave no results. About all I could gather from them was that FM was a deep dark secret, the construction of sets being done by witch doctors in fortified retreats. Then Mr. Glenn Browning announced his FM transformers. This completed the missing link—yours truly left for the nearest radio shop with cash and came home with the transformers.

All the wiring and parts up to the audio system of the GE were removed. The tuning condenser was cut down to one rotor and stator plate in each section, and an additional hole was drilled near the tuning condenser to supply a mounting for the additional tube required.

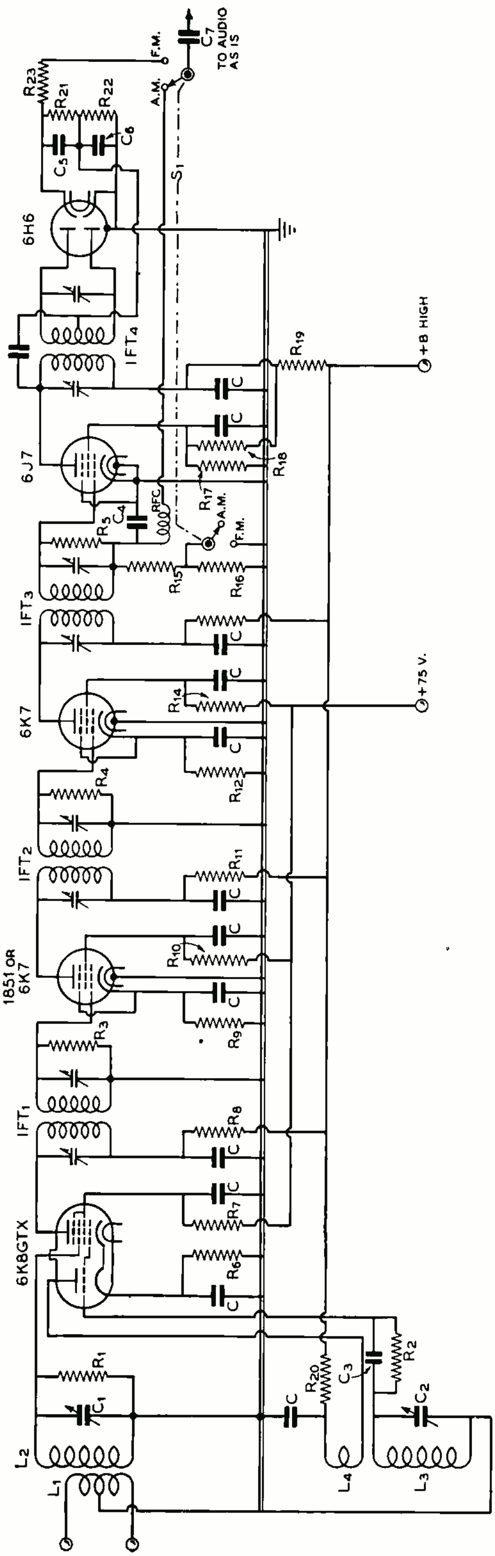
The next question was in regard to what tubes should be used. For the detector-oscillator the Hytron 6K8GTX won out, as from past experience it has been an excellent performer



Top view of the revamped b.c. chassis which has been made into an FM receiver. Note the newly installed i.f. transformers and the one rotor plate in each section of the tuning condenser.



Underchassis view of the revamped receiver. The a.f. system has been left unchanged but the r.f. and i.f. channels have been completely rebuilt to the needs of FM. Full details are given in the text.



Wiring diagram of the r.f., i.f., and discriminator portion of the receiver.

C—0.01 to 0.1 µfd., 600 volts
C_1, C_2—Rebuilt tuning condenser—one stator, one rotor, and trimmers left on
C_3, C_4, C_5, C_6—.0001-µfd. mica
C_7—0.01-µfd. 600-volt tubular
R_1—50,000 ohms, 1 watt
R_2—100,000 ohms, 1 watt
R_3, R_4, R_5—10,000 ohms, 1 watt
R_6—250 ohms, 1 watt
R_7, R_8—1000 to 5000 ohms, 1 watt
R_9—250 ohms, 1 watt
R_{10}, R_{11}—1000 to 5000 ohms, 1 watt
R_{12}—250 ohms, 1 watt
R_{13}, R_{14}—1000 to 5000 ohms, 1 watt
R_{15}—10,000 ohms, 1 watt
R_{16}—50,000 ohms, 1 watt
R_{17}—5000 ohms, 1 watt
R_{18}—50,000 ohms, 1 watt
R_{19}—75,000 ohms, 1 watt
R_{20}—1000 to 5000 ohms, 1 watt
R_{21}, R_{22}, R_{23} — 100,000 ohms, 1 watt
S_1 — D.p.d.t. FM-AM switch
RFC—2.5 mh. choke (50,000-ohm resistor can be used)
X—Limiter grid current jack
$IFT_{1, 2, 3}$—Wide-band i.f. transformers
IFT_4—Discriminator transformer

COIL SPECIFICATIONS

Forms—5/8-inch diameter
L_1—2 turns no. 28 enam. c.t.
L_2, L_3—4 turns no. 28 enam.
L_4—3 turns no. 28 enam.

on five. For the i.f. the choice of 6K7's as they were in the GE, and I couldn't see the need of 6SK7's when I had the same characteristics in the 6K7. For the limiter a 6J7 was selected for the same reason, "if you haven't what you want, you want what you have." The 6H6 was o.k. for the demodulator, and the audio could remain as is.

The wiring isn't especially tricky and with the data furnished with the Browning transformers no trouble was experienced in wiring the i.f. limiter, and discriminating circuits. Some oscillation was experienced in the i.f. when first completed, but by employing higher cathode resistors the i.f. settled down and behaved.

Rough alignment up to the limiter can be done by tuning in a strong local signal, and aligning the i.f. for maximum limiter current as indicated by a low range milliammeter plugged in at point X. I employed the e.c.o., from my transmitter, tuned to 3 Mc. as a signal generator. The det.-osc. was then tuned up by tuning to the 40-50 Mc. band with a "Squish-box" and tuning in W1XOJ on it, then tuning the 6K8GTX's circuits so that it could receive the superregenerative receiver's rush. Boy what limiter current! Then with the superregenerative receiver turned off, the W1XOJ was tuned in for maximum limiter current, which is about 0.5 to 1 ma. here with my 160-meter zepp as the antenna.

Alignment of the discriminator *can be done* *fairly well by ear,* or at least that is my experience. With an FM signal tuned in "on the nose," as indicated by maximum limiter current, the audio volume control is advanced until some form of signal is heard coming out of the speaker. It will probably sound something like a scrambled speech telephone circuit, or that brother ham across the street that overmodulates and you are receiving his harmonic on 10.

Now comes the tough part, but if you have a good pair of half way decent musical ears, you can align the receiver quite satisfactorily. First the diode trimmer, i.e. transformer secondary trimmer, is tuned so that the signal is cleared up and sounds quite natural. The plate circuit is now resonated for maximum volume and clearness. Then it is adjusted and the secondary trimmer also varied, *ever* so little either side until the signal is about as good as the average good home BC receiver. Then, watching the limiter current, the det.-osc. tuning condenser is *rocked* either side of resonance, the audio reproduction checked, and the discriminator transformer adjusted until for an equal drop in limiter current either side of resonance, the audio appears clear, and its level doesn't change. If this isn't done carefully, some quite weird effects may be noticed. You may have two, three or many spot tuning, and the signal will sound terrible.

Really decent fidelity can be secured by the above method. But don't do as I did at first, and align the receiver on a network musical program. The quality was rotten, and I thought it was the set. But when a good local musical show came on from W1XOJ the receiver put out true FM reception. Even with the 8-inch speaker the receiver sounded much better than any console BC receiver I have ever heard on the standard BC band. With a real good reproducer the set is excellent and will hold its own with the commercial FM receivers.

You may begin to wonder just how this receiver fits into the amateur pattern. Well, for the experimentally inclined who wish to listen to FM at a reasonable cost it is something quite inexpensive to begin with. For the amateur who wants a good wide-band i.f. system for FM and/or AM he could employ a low impedance link in place of the 6K8GTX plate winding on the first i.f. amplifier and employ a converter for the band to be covered. Many variations could be given, but this really isn't a construction article, but rather an illustration of how to get started with FM.

Perhaps you cannot find a GE to fit your needs. But the year the GE came out several other manufacturers came out with sets employing similar tube lineups. From my experience I believe that the only improvements possible are a stage of r.f. and a better reproducer. So if you go shopping for a receiver, find one with a three-gang condenser, and in a console cabinet if possible.

That is all, except that good intelligent choice of parts is essential. But the actual values of by-pass condensers, decoupling resistances, and layout need not be followed exactly, and changing the values of the limiter plate and screen voltages along with the limiter grid leak and condenser combination may make the receiver perform better. Also, the tone control was found to be quite helpful on the average network program where the reproduction doesn't go much above 5000 c.p.s. In this case the harshness can be removed somewhat.

●

AN INEXPENSIVE, STABILIZED OSCILLATOR

By O. K. Falor*

In the course of work-bench experiments with low-cost stabilized u.h.f. oscillators using common receiving tubes, I have run across a circuit development that promises better stability than the "pot" oscillator because the frequency-controlling element is lightly loaded, and yet provides balanced output coupling. The circuit is that of figure 1. Figure 2 gives an electrical equivalent, showing that when the plate blocking condenser is small, comparable with the tube's plate-filament capacity, a node appears along the plate coil at a point determined by the blocking condenser and the tube's output capacity. This is a convenient point to bring in the plate voltage, and across which to jump a two-wire feeder. The coil can be replaced with rods, tuned with a shorting bar, if the plate stopping condenser is adjusted to equal the tube's output capacity so as to place the node on the shorting bar. This kind of a plate circuit can be used on other types of stages to give balanced output. Neutralization can be accomplished as usual from the grid to the end of the inductance opposite from the tube, if desired.

The circuit of figure 1 was developed using a metal 6J5 on 1.8 meters, with 220 volts on the plate at about 2.2 watts when loaded. The grid tank circuit is a concentric line 15 inches long at this frequency, with no tuning or loading condenser across its open end. The outer conductor is 2⅜ inches in diameter and the ratio of outer to inner pipe sizes is 3¼ to 1, slightly below the ratio of 3.6 that is generally

*% WBCM, Bay City, Michigan.

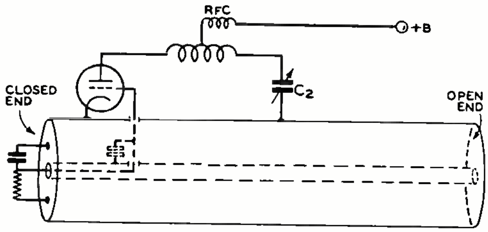


Figure 1. Semi-schematic of the coaxial-line oscillator.

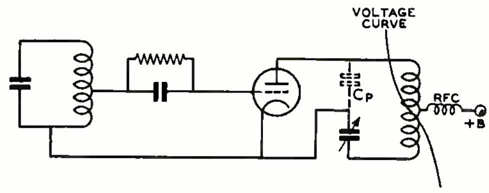


Figure 2. The equivalent circuit of the mechanical arrangement shown in figure 1.

considered optimum. The size used was the result of available metal sizes. The grid is tapped at 2¾ inches from the shorted end of the line, using a ½-inch copper strip passing through a hole in the outer conductor. This strip connects to an 866 tube clip around the inner conductor, insulated from it with mica, forming a by-pass condenser. An insulated grid lead from the clip passes through a hole into the inner conductor, leading to a grid leak and ordinary by-pass condenser at the shorting disk. The grid leak finally selected was 15,000 ohms but widely different values may work best with different tubes and adjustment. The heater is connected to the outer conductor with another short piece of wide copper strip.

The plate coil is ten spaced turns of no. 10 wire wound about two inches long on only a ¼-inch diameter. It is tapped at its electrical center which, as explained above, can be at approximately its physical center. The "series" tuning condenser is a 15 $\mu\mu$fd. Cardwell Trim-air. A two-wire output circuit can be tapped across the coil on either side of the plate voltage tap.

It was found that the unloaded plate current with 220 volts, at 1.8 meters (166 Mc.) was 8 to 9 ma. This loaded up to between 11 and 12 ma. for maximum stable output, which did not occur at the minimum plate current dip but slightly higher in frequency. Likewise, best output did not coincide with maximum grid current but on the low frequency side of the grid current curve.

Using a simple wavemeter made of a 2-inch turn of 3/16-inch copper tubing in series with a small low resistance flashlight bulb across a 35 $\mu\mu$fd. tuning condenser, the bulb lighted to over half brilliancy. The bulb had an operating voltage of 2.2 and a cold resistance of one ohm. The output, it appears, was between one and 1½ watts.

While it may appear that the circuit described above has no direct bearing on amateur problems, one will note that the grid circuit is not heavily loaded with the resistance of the tube input or output circuits, and is not burdened with an output load. A simple metal tube operates at reasonable efficiency at a fairly high frequency. Balanced output is provided if desired. The grid circuit is nearly of optimum size for better frequency control, but it can be lengthened or loaded with a tuning condenser to reach the 112 megacycle band.

●

MORE A.F. GAIN

Many of the less expensive receivers do not have sufficient gain to give comfortable room volume on signals above 18 Mc. or so when the signals are just barely above the noise level. The cause is a falling off in conversion gain and increased losses in the input circuits. However, noise external to the receiver is lower on these frequencies, permitting reception of weaker signals if the receiver has sufficient gain to drag them in.

Obviously the preferred method of bringing up these weak signals to good room volume is to increase the gain of the r.f. circuits, especially the high frequency input circuit. This, however, entails a major operation on the receiver, or a pre-selector. A simpler method is to increase the a.f. gain.

As perhaps 80 per cent of these receivers employ a single 42, 6F6, 6K6, 41, 6V6, etc., in the output stage, the gain can be increased with little trouble by substituting a 6AD7-G for the output tube and making minor circuit alterations. This tube is simply a 6F6-G with a small triode having a mu of 6 in the same envelope, and was designed primarily for phase inverter service in conjunction with a 6F6-G. However, when used as a straight resistance coupled amplifier the small triode unit will give a gain of 4, which is equivalent to two "R" points.

If the receiver employs a 6K6, 6F6, or 6V6 (or glass equivalent), the only parts required

[*Continued on Page 88*]

U. H. F. . . .

By E. H. CONKLIN, W9BNX*

"The u.h.f. dope in the October issue was fine. I hope that you will continue to devote a lot of space to the ultra-highs."

"Please give us more photographs of successful stations, including close-ups of the apparatus and antenna system."

"We need more discussion of theory."

Such are the comments received in recent months by the U.H.F. Editor. But a good part of what goes into this column comes from the men active on the ultra-high frequency bands. If you want more pictures, set an example by sending in a few yourself. If you want more discussion of transmitters, receivers, etc., start by sending in the story of your own equipment.

This column is a clearing-house for u.h.f. ideas, contacts, and experiences but it should not be a sounding board for the ideas of any man or small group. There are no policies fixed upon it, such as that it should contain predominately chatter, technical, or operating notes. Some of the boys are providing real help by reporting on their visits to other stations, sending in the news, ideas, and photographs of the other station. A little more of that will help us all to see how the other fellow does it, what his results and ideas are. So let's all help to make use of the space that is being given to us each month, and use it to the best advantage.

More DX Openings

On November 12, there was five-meter dx of the Aurora type, according to W8OKC who missed it, unfortunately, but during the evening W8FDA worked W8CIR and heard W1LLL HDQ KLJ HXP(?) W3BYF. Signals were fuzzy. OKC's signals at FDA were stronger than usual that night. The band appeared to be open at W6QLZ on November 18 with some six carriers from 56.4 to 57.2 megacycles, but they were all too weak to read.

W4FKN in Atlanta reports working W4FVW and W4EDD in Florida starting at 7 p.m. Central time on December 2 while ten meters was open for short skip. This adds another state for FKN. In Dallas, W5AJG had the "smell" of the opening for two or three days, he says, and found a nice one from 6:15 to 8:45 on the same night. He heard W4FLH EDD W6QLZ and worked W4FBH EQM FVW W6OVK SLO. There were not many stations on the air but all were of excellent signal strength with little fading.

W6QLZ heard the band open at 7 p.m. Mountain time when W5AJG EHM came through R9. At 7:12 Clyde heard W9ZHB working W9RGH, and at 7:28 W4EDD came in with a CQ saying, "What say over there, EHM, AJG or QLZ?" Clyde stayed after Robbie for an hour during which EDD sent out three CQ's in a row, apparently without a contact. EDD was R8 at first. He went out at 8 p.m. and came back fifteen minutes later with an Aurora-type fuzz. W4GHW was heard on 57 megacycles but may have been a harmonic. W6OVK says that he and W6SLO worked both W5AJG and W5EHM with R9 plus signals both ways. From 7 to 7:45 they both heard W4EDD working W9's and coming in R7 at SLO but only one or two R's above the noise level at OVK. An unidentified W4 on about 56.8 was heard, and there was another unreadable five-meter station at the low end of the band. Harmonics of ten-meter stations came through until after 9 p.m.

The above long-distance work looked very much like some of that unusual double hop, especially with the W5's working both ways from the middle. The mention of Aurora fuzz by QLZ suggests that there may have been some of that type of propagation involved, but the loud signals reported by all hands makes it look like just another good night of Sporadic-E layer reflection. It is too bad that more stations were not on the air at the time to enjoy the opening, which seems to have been one of the best especially for the southern half of the country. It is difficult to explain why W6QLZ and W4EDD did not hook up, which would have made an important contact for both. In fact, it is thought that such a contact would give QLZ his missing district, and put EDD way up to where he would need only a W7 (and what a hop it would be for a Miami station to make a W7 contact!).

On the very next night, the 3rd, W5AJG found the ten-meter band very poor and spotty with only K6 coming through (long skip via F_2 layer) but he let out a call on five. Several days later he received a card from W9AZJ-KQA saying that he had picked up Leroy R9 and steady. Leroy thought he had a monopoly on the secret of making dx contacts on an apparently dead band—but the absence of any other reports suggests that the reception just *might* have been on the previous

56 Mc. DX HONOR ROLL

Call	D	S
W9ZJB	9	28
W9USI	9	23
W9USH	9	18
W9AHZ	9	16
W5AJG	9	34
W1DEI	8	20
W1EYM	8	20
W1HDQ	8	26
W2GHV	8	24
W3AIR	8	24
W3BZJ	8	27
W3RL	8	29
W6QLZ	8	20
W8CIR	8	32
W8JLQ	8	
W8QDU	8	25
W8QQS	8	17
W8VO	8	
W9ARN	8	17
W9CBJ	8	
W9CLH	8	
W9EET	8	15
W9VHG	8	
W9VWU	8	16
W9ZHB	8	29
W2AMJ	7	22
W2JCY	7	
W2MO	7	25
W3BYF	7	22
W3EZM	7	24
W3HJO	7	
W3HOH	7	17
W4DRZ	7	22
W4EDD	7	
W4FBH	7	17
W4FLH	7	18
W5CSU	7	
W5EHM	7	
W8CVQ	7	
W8PK	7	9
W8RUE	7	17
W9BJV	7	12
W9GGH	7	
W9QCY	7	15
W9IZQ	7	14
W9SQE	7	22
W9WAL	7	
W9YKX	7	13
W9ZQC	7	12
W9ZUL	7	18
W1LLL	6	24
W1CLH	6	13

Call	D	S
W1JFF	6	11
W1JJR	6	17
W2KLZ	6	
W2LAH	6	
W5VV	6	18
W8LKD	6	11
W8NKJ	6	16
W8OJF	6	
W9NY	6	13
W1GJZ	5	15
W1HXE	5	18
W1JMT	5	9
W1JNX	5	12
W1JRY	5	
W1LFI	5	
W2LAL	5	11
W3CGV	5	10
W3EIS	5	11
W3GLV	5	
W3HJT	5	
W4EQM	5	8
W6DNS	5	
W6KTJ	5	
W6OVK	5	10
W8EGQ	5	10
W8NOR	5	16
W8OKC	5	10
W8OPO	5	8
W8RVT	5	7
W8TGJ	5	9
W9UOG	5	8
W9WWH	5	
VE3ADO	4	
W1LKM	4	6
W1LPF	4	16
W3FPL	4	8
W4FKN	4	8
W6IOJ	4	4
W7GBI	4	6
W8AGU	4	8
W8NOB	4	
W8NYD	4	
W8TIU	4	8
W1KHL	3	
W6AVR	3	4
W6OIN	3	3
W6PGO	3	6
W6SLO	3	3
W7FDJ	3	3
W8OEP	3	6
W9WYX	3	3

Note: D—Districts; S—States.

evening. It would be interesting to have AZJ-KQA recheck this date.

W6QLZ heard W5VV for a short time on the 5th. Then again on December 9, W5AJG heard W4EDD FVW for a few minutes around 6:15 Central time but could not raise them. On the 13th, W6SLO OVK worked W5VV for over an hour except for some periods of bad fading. VV said that when SLO was loud, OVK was weak, and the reverse, although the two W6's are only 2½ miles apart. These openings in November and December were quite frequent for the winter half of the year, and served to impress some of the gang with the value of being on five making local contacts, and occasionally checking the band for dx signals.

Long Ground Wave DX

Last month, the establishment of five-meter contacts between W6OVK near Tucson and W6QLZ near Phoenix was reported. In a card dated December 3, OVK reported that W6SLO also works QLZ during the schedules but has not been able to raise W6KTJ although OVK hooked him twice with fair signals. OVK has improved his receiver and antenna, so QLZ now goes up to 72 db often. Jim says that the signals are good in the early morning, noon and night. He adds that horizontals seem far best both for ground wave and skip, in his experience. In a note he adds that W6QLZ KTJ GBN SLO OVK are all working the ground wave dx now.

W6QLZ said that he was getting through to Tucson every night, on twice a day schedules, up to December 19. Signals get as high as 75 db at 5 o'clock in the morning, and they can work phone at any time of the day or night, though at times fading gets bad. Signals are best from 9 p.m. to dawn and bad during the daytime or whenever there is short skip on ten. He sends in some pictures of the mountains between Tucson and Phoenix, taken from both ends, the latter by moonlight! Only, his pencil pushed through from the back when he wrote on the prints, and they will not reproduce well. The South Mountains are about 15 miles southeast of his ranch, forming a continuous barrier for 30 miles. About half way between are the Picaco mountains, some 35 miles from Phoenix. At W6OVK's end, a picture taken from his back yard shows the Catalina mountains ten miles away with Mt. Lemmon at 9200 feet right smack in the center and hardly any higher than the rest of the range. These will seem like formidable barriers to the sea-level boys, but their size is hacked down by the altitude of the cities themselves.

Another Success Story

On December 10, W9YKX in Woodbine, Iowa—between Des Moines and Omaha—wrote saying that the beam described here recently was cleared off the rotating head by a blizzard on Armistice Day, but it has all been replaced. He now uses three elements with quarter wave spacing, fed with Q bars and a 1½-inch line. He learned that W9ZJB near Kansas City had a similar horizontal beam, and made schedules. Tests with W9NFM at Solon and W9HAQ at Davenport, some 300 miles across Iowa, were not successful at first attempt. He had not found anyone in Des Moines with whom he could test. He wished that he had some suitable dx on which to test the sensitivity of his concentric-line converter, but his longest ground wave dx had been W9TTL forty miles away who comes in at from 54 to 66 db.

In the same mail, one of a series of newsy letters arrived from W9ZJB. He had moved to his new location at Gashland, Missouri, about ten miles north of Kansas City, and found receiving conditions fine. Ten-meter signals from St. Joseph, fifty miles away, came in with just a piece of wire in the room for an antenna. He had a 40 foot tower up and a "three elephant beam" in the basement, awaiting a break in the weather at "Megacycle Farms," which he expected to feed with 120 feet of 2-inch line of no. 14 wire and a half-wave stub. The spacing of the elements is a quarter wave. The next letter proclaimed that Vince was about ready to give up five meters, raise a bunch of kids and warn them away from u.h.f. stuff, because he could find no point on the half-wave stub to which he could match a 500-ohm line. He had excited the array from a small antenna inside of his house a hundred feet away, and found plenty of juice in the stub according to the galvanometer there, when tuned to resonance. The feed line alone barely loaded the transmitter, and the array did not pull enough more out of the final to look right. He used 8½ feet of 5/16-inch tubing in the stub, so it appeared that the stub might have acted as a pair of low impedance *Q* bars in parallel at the center of the stub, with too low an impedance, but that was not it.

At Last!

The next letter brought the news that the beamless beam turned out to be a whopper. Vince found that the final was not properly neutralized, so would not load properly. After he took care of this and put the link on, it took right off and two minutes later he was in contact with Bill Copeland, W9YKX, just 190 miles away! Vince says, "As much as I hate to admit it, horizontal polarization seems to be something. But don't brag too soon, as Bill and I are going to change to a vertical H with reflector just to see what this thing is that you and W9ZJB rave about." *(What,* an eight element vertical as against a three element horizontal? Unfair!—Ed.)

ZJB worked YKX for three hours starting at 7 p.m. About that time, W9CXU who is six miles from ZJB was working a station 150 miles away in Boonville, Missouri, on the "reflecto-wave stuff" on ten meters. We'll soon see if Vince and Bill just hit it lucky, or can repeat at will. Vince signs off with, "Best for now and, Boy! Have I a swell antenna? Heh, Heh!!"

Super Regen Comment

A reader brings up a point about Frink's paper on super-regen receivers, partly reviewed in RADIO for January. One of the several advantages to introducing the quench voltage into the detector via the grid leak was stated to be the separation of the quench voltage from the audio voltage in the plate circuit, eliminating the necessity for a shielded transformer to keep the quench voltage from overloading the audio tube. It has been pointed out that the smaller quench voltage required is, nevertheless, amplified in the tube so that it appears in the plate circuit in amplified form, and practically the same output problems are involved.

That point has bothered your conductor, too. If the quench voltage is injected in series with the plate voltage, it all must pass through the audio transformer primary or its by-pass contenser to modulate the h.f. oscillations. On the other hand, if this voltage is injected in the grid circuit where it blocks the tube periodically, the amplified component that appears in the plate circuit is no longer needed as such, and brute force filter methods can smooth out the plate circuit variations to leave only the audio to go through the transformer. The difference, therefore, seems to be not in whether there is a quench voltage component in the plate circuit, but whether it may be filtered out in simple fashion and still allow superregeneration.

Tuned Filament Oscillators

The other day, W9PNV telephoned about the adjustment of his new 112-megacycle antenna. The old Sterba "folded" vertical came down in a storm and was replaced with a stack of four vertical extended half waves, center fed and connected with short phasing stubs. The feeder hooks onto the plate rods through blocking condensers. In adjusting the antenna coupling it was necessary to change the feeder taps on the plate rods. This caused a shift in transmitter frequency and made it necessary to bring it back by moving the shorting bar, all of which is inconvenient, at least, and makes the adjustment difficult.

The transmitter was one with tuned filament rods and grounded grids, a type that your conductor personally dislikes as being wasteful of pipe and not making the most of facilities to keep the frequency constant under modulation, etc. A fundamental requirement for oscillator stability is that the frequency controlling circuit have a high *Q*. This requires that the controlling circuit have a large amount of inductance for the resistance it contains. For a given frequency and amount of inductance, therefore, the *Q* is related inversely to the amount of resistance in it or coupled to it. As a result, it is not desirable to couple resistance into the controlling circuit by allowing it to radiate, to couple it to an antenna, or to damp it by burdening it with tightly coupled grids which have low input resistance at very high frequencies.

The tuned filament type of oscillator, by grounding the grids and placing a tuned circuit in the filament leads, has the grid input resistance connected across the whole tuned circuit. Because of this loading, the plate circuit generally determines the frequency because it has a higher *Q* even with the antenna coupled to it. This is disclosed by the fact that the oscillator continues to operate over a wide range of plate line lengths without requiring a change in the filament tuning. Under these conditions, the frequency stability is unlikely to be much better than in a coil-tuned grid circuit using the same plate rods.

If the filament rods are moved around to the grid and the grids tapped way down on the rods, better stability results so long as the grid leads are short and made of wide, low-inductance leads. If the filament leads are long within the tubes or outside them, half wave lines may improve the output, but the function of these lines is nothing like it would be in the tuned filament circuit. Neutralizing condensers will further reduce reaction of plate circuit changes upon the frequency controlling grid circuit. Experience with this straight-forward t.p.t.g. type of oscillator indicates that the plate-rod shorting bar must be within as little as a half inch or less of the proper point in order for the tubes to oscillate, if the grid circuit is really operating correctly. In this condition, little trouble is had in coupling out the power even into a line that does not act like a pure resistance, because changes in the shorting bar to compensate for feeder reactance do not have much effect upon the frequency.

2½ METER HONOR ROLL

ELEVATED LOCATIONS

Stations	Miles
W6KIN/6-W6BJI/6 (airplane)	255
W6QZA-MKS	215
W6BKZ-QZA	209
W6QZA-OIN	201
W6BCX-OIN	201
W6NJJ-NJW	175
W1DMV/6-W6HJT (airplane)	165
W9WYX-VTK	160
W6KIN/6-W6OMC/6	140
W6IOJ-OIN	120
W2LBK-W1HDQ	118
W1HDQ-W2JND	105
W6BCX-IOJ	100
W1HDQ-W2IQF	100
W1HDQ-W2GPO	100
W6NCP-OIN	98
W1KXK-MNK/1	81
W6IOJ-OIN	80
W6CPY-IOJ	80

HOME LOCATIONS

Stations	Miles
W1MON-W2LAU	198
W8CVQ-QDU (crossband)	130
W1IJ-W2LAU	105
W2ADW-W2LAU	96
W1HBD-W1XW (1935)	90
W2LBK-W1IJ	76
W2LBK-W3BZJ	76
W1MWN-W2LAU	75
W1SS-BBM	74
W1KXK-IZY	73
W1MRF-W2LAU	68
W2GPO-LAU	50
W1LAS-W2LAU	45
W1LEA-BHL	45
W2JND-LAU	44
W2MLO-HNY	40
W3CGU-W2HGU	40

1¼ METER HONOR ROLL

ELEVATED LOCATIONS

Stations	Miles
W6IOJ-LFN	135
W1AJJ-COO (crossband)	93

Concentric Oscillators

The advantages of concentric lines over parallel rods for frequency control appear to be mainly the lower resistance of the large outer conductor and the fact that larger dimensions do not result in more radiation, thus reducing the Q after an optimum size has been reached. The same general comments of the above section about tuned filament oscillators apply, however, in that the line that controls the frequency should not be loaded. The radiation factor in a two-wire line might be eliminated by placing the line in a copper box.

The comment made in this column several years ago to the effect that shield cans might do for concentric line outer conductors seems to have been put to some use in the east, especially in the form of the "pot" oscillator. This oscillator can be looked upon as having a concentric line plate circuit, but with the peculiarity that the inner conductor is grounded and the outer conductor is left to float, except that it hooks on to the plate of the tube. It is then advisable to box this line in with another can, which also provides a very large capacity which "loads" the line and makes it operate as would a longer section of line. Another condenser is placed across the plate circuit to load it further if the line, built for 1000 megacycles or so, is to be used on 112 megacycles. The tube's plate circuit is slapped right across the line, loading it with resistance. The antenna is coupled into the line, further loading it and reducing the Q. The grid is coupled in with a straightened-out hairpin that provides regeneration and adds a little more resistance to the already burdened coaxial line. The result is an oscillator which, while it may be more stable than a coil-tuned job, is hardly an example of the present state of the art of frequency control with coaxial line elements.

O. K. Falor at WBCM, Bay City, Michigan, has continued to work on his "beer-mug" versions of the pot oscillator. He has made use of longer lines, easily made with sheet copper wrapped around a rolling pin and soldered. He has developed a single ended oscillator that provides balanced output for a two-wire feed line, and yet the grid tank is lightly loaded. A description of it appears in this issue of RADIO's *With The Experimenter* department. If anyone else has had interesting experiences with u.h.f. equipment, let's have them, either for this column or for an article elsewhere in the magazine.

Five-Meter Miscellany

Several months ago, W8QDU noticed that he had worked 40 of the honor roll stations. W5AJG finds that he has worked 66, and has received heard cards from nine more. This *sounds* like there is far more chance of working one's friends on the five-meter band than there would be of doing it on some more crowded band!

Leroy, W5AJG, has been running tests three times a week with Wilmer Allison, W5VV, who is in Austin, Texas. The distance from Dallas is some 200 miles or more, and nothing has come of it. Leroy wonders if there are any of those temperature inversions down Texas way. Will some weather map expert check into it and advise him? Our auld friend Mel Wilson, W1DEI, is here and there and everywhere these days, so is of little use to us for such purposes.

Down Oklahoma way, Ed Harris of W5TW at Hugo is having a bit too much fun with a plumber's version of the three-element array. It is to be hoped that his troubles will be cleared up promptly, like those of W9ZJB. Anyhow, Ed hates to have to try to get a refund on the plumbing.

In Tucson, W6OVK now prefers horizontals, having had such good luck working Phoenix. W6QLZ still holds forth on dx openings and on ground wave work. How these boys can comment on signal strength at five o'clock in the morning is beyond us. OVK and QLZ lined up their receivers and beams, after OVK put up one of QLZ's four-element arrays, resulting in R9 signals at both ends. According to reports to this column, only some W7's made W6 contacts last summer that were not with Arizona. QLZ says that some day the band will open for someone who will get 40 answers to his CQ—all from Arizona! He and OVK are pounding out letters to hams all around the state to get them on five. Here are some of the results:

W6QAV in Tucson has put up a QLZ four-element horizontal beam. PGO is also putting one up and is rebuilding for five. GBN, Tommy Carter, is a railroad operator at Estrella Hill about 46 miles south of Phoenix, but without an a.c. line. He has a 6K8GTX converter working into a three tube t.r.f. receiver operated from batteries because the a.c. plant is too noisy for the high frequencies. A QLZ beam will be up soon. He has a 6L6G e.c.o. working into another as a five-meter doubler, on c.w. only. Clyde says that it is steadier and better than almost any crystal controlled five-meter rig he has heard. GBN used a superregen before he got the converter operating, and heard W5VV on it December 13, working OVK.

In Pennsylvania, W8OKC FDA are still working practically 100 per cent nightly on code. OKC tried a horizontal double extended zepp but signals dropped out completely at both ends, FDA apparently not changing his. OKC's 133 foot long horizontal wire pointing at FDA, with part of it vertical, puts in a signal

[*Continued on Page 90*]

Away With HAYWIRE!

By E. H. CONKLIN,* W9BNX

The Editors of this magazine say that a good percentage of amateur transmitters nowadays are all dressed up in cabinets or racks, without any more of that old breadboard stuff with wires running all over the place. The best answer to that seems to be, "Oh yeah?"

It may be that way, out where the Sunkist California Kilowatts grow, but here in the midwest there are still plenty of breadboard kilowatts and lesser breeds of the same animal. Where someone has gone ahead and mounted the rig on chassis and panel units held in a cabinet or rack, one of two conditions generally prevails. The back is covered with the same old maze of leads going here and there, or the same leads have been adjusted in length and cabled together.

The latter makes a nice looking job, but the chances are a thousand to one that the same bunch of cabled leads go to more than two units in the rack, and may even include power, switching or keying connections going outside of the rack to a table or power line. Such a job will withstand just about one visit from the decorators or movers, and will require much tagging of leads and clipping on of extensions should it become necessary to pull out one unit alone for test or change while still connected to power supplies and other units.

Must transmitters be that way? Can they be remodeled slightly to avoid binding posts, permanently cabled leads, and inconvenience resulting from a lack of flexibility? For some time, the writer has had a dream that if someone would draw up a set of principles relating to interconnecting the units of a rig, and if others would improve on the suggestion, some kind of a standardized procedure might be adopted quite generally. When the idea was proposed to a friendly critic, he said: "Naw, everyone wants to do things differently. So, it would not work." But there is still the possibility that a system can be worked out that will apply generally even to different rigs.

Upon glancing at a transmitter layout in a handbook, it was noted that there were 63 binding posts on it, exclusive of the power line and control switches. That was about enough to blast the dream sky high but, finally, added conviction to the thought that something should be done about it, and at a cost comparable to that of the binding posts themselves.

The suggestions that are to follow, therefore, do not represent an attempt to direct the lives and actions of every ham, but to draw discussions and suggestions out of our readers which, in the end, may lead to a real solution to the haywire connection problem. The author of this article and the Editors of RADIO will look forward to receiving comments, suggestions, and even photographs of how the other fellow does it or believes that it should be done.

The Requirements

The first thing that we need, in almost every case, is a place to hook on the 110-volt line. A pair of fuses can follow, for protection and to avoid having to run down to the basement to replace some at the main fuse box. A main switch is in order for safety or master control. Also, we need some provision for supplying the receiver, frequency meter, monitor, soldering iron, or whatever else may require line voltage from utility outlets. Then comes a switch to turn on the heaters in the transmitter which normally run during the whole time that the receiver is going—and, in fact, the receiver connection might follow this switch instead of the main line switch. During standby periods, filaments and bias supplies may be left on, so they generally require a second switch. Next comes a switch for the high voltage and other plate supplies which are normally turned on

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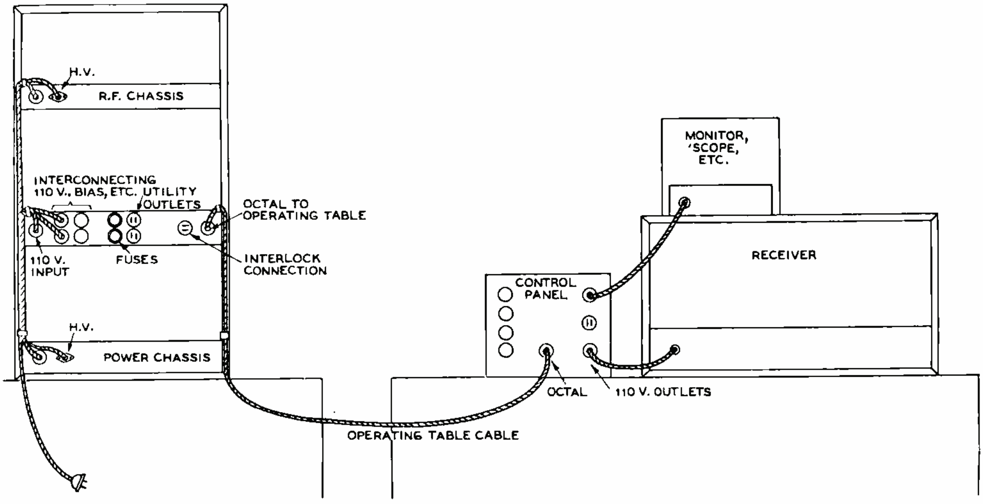


Figure 1. Rear view of the transmitter and the operating position showing the interconnecting cables and transmitter chassis connections.

for each transmission, after rectifier filaments have been warmed up. In some cases, there must also be provided a switch for turning on the modulator plate supply and for removing the voltage from the speech equipment when the key is used. The remaining connections external to the transmitter rack are for the key and microphone.

A Terminal Unit

So far, only the external connections have been mentioned. That will be enough for a start, even though everyone is familiar with the common method of using a series of switches to take care of most of the jobs that have just been outlined.

In some stations, the line is connected to some kind of a switchboard at the operating position, from which several sets of power leads go to the rig. This system is fairly satisfactory but may result in the old trouble of too many wires going back and forth, or with leads tied together so as to prevent the wife from moving the operating table to dust behind it. An alternative, which will cut down the cabling job and inflexibility, for everything except the usual shielded microphone cable, is to have a panel unit in the rack, or the back side of some chassis, reserved for the job of being a terminal board.

The rear view of such a board will be seen in figure 1. Here, provision has been made for a number of items, as follows:

1. Male socket to receive the 110 volt line.
2. Main (mercury) power switch on front panel.
3. Main power line indicator light.
4. Two line fuses.
5. Female sockets for utility outlets.
6. First toggle switch, on front panel.
7. Female outlets for receiver, monitor, etc.
8. Second and subsequent toggle switches on front panel.
9. Indicator lights for toggle switches.
10. Octal (or other) socket to take cable to switches and key on the operating desk.
11. Several octal (or other) sockets, to carry 110 volts to each chassis in the rig and to bring keying circuit down to the terminal unit, plus power and bias interconnection.

Pro and Con

Now, let's go back over these and discuss the reasons. The male rather than female 110-volt line receptacle permits the use of ordinary drop cord connections, without a special cord with a male connection at each end. Also, the prongs on such a cord would be hot and might become shorted when an attempt is made to plug into the rig, if the other end is already connected to the line. Another common 110 v. outlet, in series with the first one, can be provided for connecting the cabinet door interlock switch if one is used.

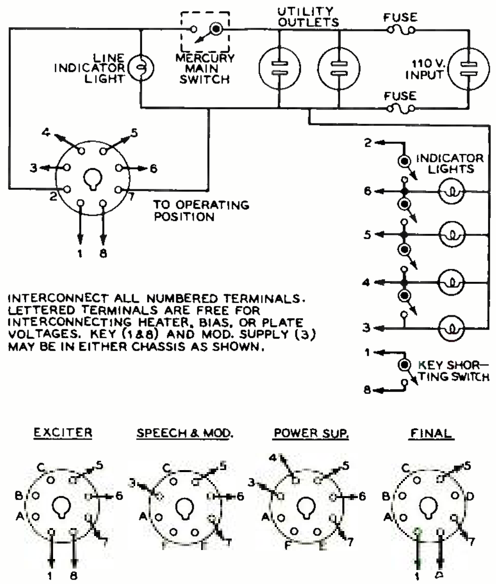


Figure 2. Simplified schematic of the interconnecting wiring at the transmitter.

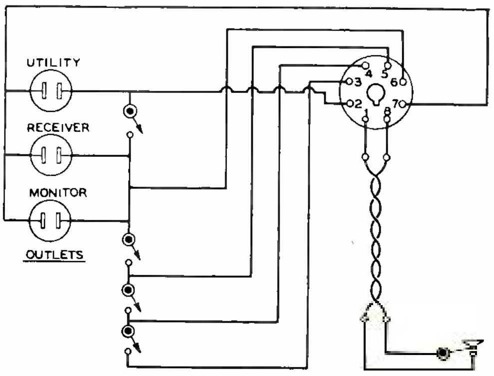


Figure 3. Schematic of the wiring at the operating position.

Mercury household light switches make no noise, and can be mounted on a panel without the use of a front plate. A better main power switch, from a safety standpoint, would be one of these push button motor switches with a large red "off" button that you just cannot miss when you poke at it in an emergency. An indicator light on the panel to show line voltage may be desired at this point, following the main line switch. A pair of fuses, rather than just one in the ungrounded side of the line as commonly used now in home lighting circuits, can be mounted on the small chassis in back of the panel, as a safety and protective device that will open regardless of the polarity of the line plug, before the house fuses blow.

Provision has been made in the above list for one or two utility outlets for soldering iron or testing other equipment. One such outlet might be placed on the front panel rather than at the back, for convenience. Nice looking outlets are now available. If the receiver is plugged into one of these, in the rear of the rack, it will be necessary to have a line running from the rig to the receiver, and to use the receiver on-off switch. Both of these things can be eliminated by plugging the receiver in at the operating desk switch panel, after the first control switch, which turns on the transmitter heaters, and by running both sides of the line in the cable to the operating desk as will be described later.

The toggle switches on the terminal unit panel may be omitted but sometimes are convenient when tuning a transmitter that is located out of reach from the operating position. They are in parallel with the cable to the operating position. An extra toggle placed across the key leads is also a convenience. Indicator lights on the terminal unit panel will dress up the rig and be of some help in calling the attention of the operator to the status of the transmitter switches. Such lights can be on the terminal panel, operating position panel, or separate chassis, or on all of them if desired, with no change in the interconnecting wiring. A red jewel is preferred for the high voltage indicator light, which may be hooked in parallel with a danger signal inside of the transmitter cabinet. A 110-volt bulb or a resistor in series with the h.v. primary, shorted by a switch, can be placed on the terminal unit or at the operating position to provide a means for reducing power. A double throw h.v. toggle switch can be used for low and high power.

Let us consider next the control cable to the operating position. While screwed-down connections are to be preferred for equipment which must not fail during years of operation, plug-in methods are more suitable for amateurs. Special heavy duty multiple connectors are available, but for nearly every amateur purpose, ordinary octal sockets and plugs will serve. Where the high voltage supply draws too much current for this arrangement, it is possible to use the cable to the operating position not for the actual power lead for the heavy duty pack, but for field current for a relay mounted on the terminal unit or on the power supply chassis. A suggested arrangement of the octal connections for the control cable is given in figure 2. Like all other cables, this one should have a plug at each end. It is often desirable to turn on the crystal supply with the high voltage switch so that there is no interference in the receiver until the high voltage switch is thrown, which can be arranged easily in this wiring system.

This cable can plug into a small control panel mounted at the operating position, where the key and switches together with utility, monitor and receiver outlets, are located. Bringing both sides of the 110-volt supply through this cable eliminates the necessity for having more than one cable leading to the operating desk, for any purpose other than for shielded microphone leads. The control switches are placed in the usual series arrangement, each in parallel with the similar toggle on the terminal panel, as shown in the operating position hookup, figure 3.

Connections to Other Chassis

An adequate number of octal sockets should be provided, equal to the largest number of chassis that are likely to require 110 volt, bias, or power supply connections. These sockets may be wired in parallel with the socket for the cable leading to the operating table, except that one 110-volt line connection is not necessary, releasing this terminal for other purposes. It is only the use of extra terminals that would make it somewhat desirable to have a different type of connector or socket than used to the operating position. If this group of outlets is adequately marked, however, it may be satisfactory to use the same octal sockets throughout. If the outlets are individually marked and reserved for connection to specific types of apparatus, such as power supplies, modulators, etc., some of the other 110-volt or keying connections will become unnecessary on certain sockets, making available several additional terminals for bringing plate voltages or bias connections from one unit to another.

The cables that connect to these outlets, like those to anything else in the rig, may have a plug at both ends. A female type could be used at one end and male at the other, if preferred. This should be standardized, however, so that only a few seconds are needed to disconnect any chassis and move it out to the work bench for a check-up or change, and tested while connected to the rest of the rig through one or more long extension cables. These cables can be just like the others except for length, or can have a female receptacle at one end so that they can be connected to the short cables that they extend, adding a little extra length. Or the cables can be standard and a double female connector can be arranged cheaply so that the extensions can be used alone or in series with the regular cables if more length is needed.

If a meter and switch are to be placed on the terminal unit panel, an octal connector can be used to bring the voltages to the terminal chassis, preferably using the system in which 20-ohm resistors are placed in each circuit to be metered, and the meter switched across the resistors. This method requires two leads for each circuit and limits an octal connection to four circuits, unless several of the circuits have a common side and can be run through a common lead on one other pin. The latter arrangement is not as easily standardized, but may be suitable for specific rigs. This method of metering allows a unit to operate with the meter connection removed, because no circuit is broken and none needs a jumper when the plug is out.

Power from one chassis to another may be brought up through the spare pins on the terminal unit receptacles or may be carried directly from the power chassis to the modulator or r.f. chassis on the usual octal connectors and cords. The selection of pins for these voltages if connected directly may be the same as for a 6L6 or 6F6 socket, so that the connections will be consistent with those mentioned in the following paragraph.

It is often desirable to connect into a receiver or transmitter to use the power in an "outboard" rig. For that purpose, a straight-through plug and socket connector can be made up with leads connecting to filament and screen pins to tap onto these voltages. As a general rule, however, it will be convenient to place an extra octal outlet on each chassis containing a power supply, from which all of the a.c. and d.c. available there can be obtained. Inasmuch as tube types 6F6, 6L6., etc., have pins no. 2 and 7 for the heater and no. 4 for the screen, these plus the missing no. 6 or unused no. 1 for the negative (ground) will make a suitable standard set-up for tapping in on power supplies.

The number of interconnecting leads is reduced by placing low voltage and bias supplies on the same chassis as the audio or r.f. stage supplied by them. The saving in panel and chassis cost will just about pay for the supply anyway. Where this power is brought from another chassis, the number of interconnecting leads can be held to a minimum by putting voltage dividers on the terminal unit or the audio, or r.f. chassis where used, if several d.c. voltages are to come from a single supply.

Where a lead must go from one chassis through a second to a third, the interconnecting system works out somewhat better if the lead goes directly from the first to the third chassis,

[*Continued on Page 85*]

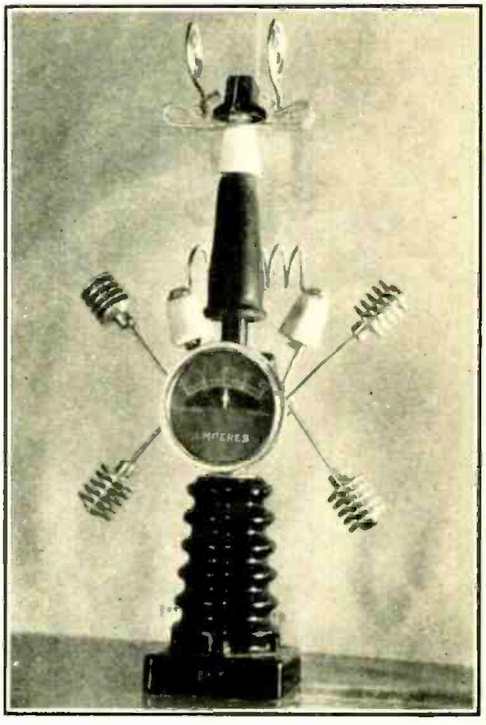
YARN *of the* MONTH

A PRACTICAL DIALOGUE METER FOR THE AMATEUR

(This simple but highly effective instrument represents a new development in phone communication, and, as such, is another scoop for RADIO. *We sincerely hope that its use may become as universal as has inadequate means of frequency measurement.*—Editor)

After some years spent observing phone signals (including my own) on the various bands, I came to the conclusion a year ago that the phone amateur does not need more power, more efficient amplifiers, better receivers, extended positive peaks, or even narrower audio ranges for voice work. Instead, what he really needs is a practical means of measuring the effectiveness of the speech input *to his microphone* in order that he may utilize to best advantage the power of his present station. Accordingly, I spent the following months laboriously designing, perfecting, and simplifying this Dialogue Meter. I now offer it in its perfected form as my contribution to the art of amateur communication.

Since so many amateurs alter their voices and personalities when confronted with a microphone, and since I knew that further amplification would be necessary before it would be possible to measure the effectiveness of the amateur's dialogue, I decided to apply these measurements directly to the *output* of the station. At first I was afraid that the audio garbling and distortion found in so many amateur transmitters would influence any reading obtained from a measurement based on its output. However, after a series of painstaking tests, I found that the distortion introduced by even the poorest ham transmitter was insignificant in comparison with the distortion introduced prior to the microphone, and hence poor quality of the station itself did not influence the readings. Furthermore, I found that the combination of audio and radio frequencies in the output of the transmitter lent itself admirably to measurement by a dialogue meter,

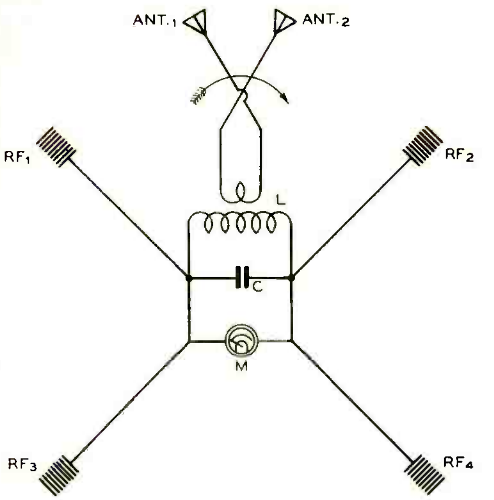


A closeup study of the device. Note the concentric spiral beam antennas which give a theoretical gain of 3 db over no antenna at all.

so it is only necessary to place this meter in the radio-frequency field of your transmitter to check on your dialogue.

The constructional details of the meter are self-evident from the photograph and diagram, but a few words are in order about the various parts used. The circuit is a modification of Professor Neutradine's Superbloop Radio-frequency Rectifier which appeared in RADIO for

By W. T. CASWELL, Jr., W5BB



Wiring diagram of the dialogue meter.

C—Fixed condenser: see text

L—6.008 turns no. 14 enam., ½" dia.

M—20-0-20 thermovoltammeter

RF_1, RF_2, RF_3 RF_4—Rectifying fins

ANT_1, ANT_2 — Concentric spiral beam antennas: see text

December, 1918, and the rectification is accomplished by means of the rectifying fins $RF_{1,\ 2,\ 3,}$ and $_4$. These fins are constructed of alternate layers of aluminum, cadmium, tantalum, and geranium, and are connected in a push-pull full-wave circuit. The thermovoltammeter is calibrated in this case from "charge" to "discharge," but it could be calibrated with the conventional "plus" and "minus," or the more positive "yes" and "no." The pickup antennas 1 and 2 are maintained in phase by the control shown between them, and have approximately three db gain in the direction of their spiral. The coil and condenser shown as L and C are a vital part of the unit, and together tune to the frequency of your favorite BC station, which is used to maintain the meter at its zero position. (However, some radio comedians may cause a slightly negative deflection, and one movie actress—name on request)—caused an observed positive deflection of 10 points.) The fixed condenser C is clearly marked in the modern manner by its manufacturers with two stars, a crescent, three red dots, and a gob of soldering paste, but its real value will have to be determined by individual experiment.

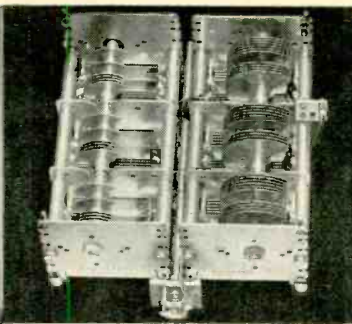
The use of this meter is simplicity itself. After placing it in the radio-frequency field of your transmitter, make a contact over the air with some other amateur, and observe the effectiveness of your dialogue as shown by the meter. Caution in the use of this sensitive instrument is advisable, however, and it should not be overloaded by very long or wordy transmissions. The rectifying fins become noticeably warm at the end of a five minute transmission, and melt after approximately ten minutes of uninterrupted use. To obtain a positive meter reading stress clarity, brevity, naturalness, friendliness, and, above all, *logic*. The continued repetition of one word, such as the pronoun "I," (or, worse yet, the pronoun "we" when the operator really means "I") is apt to bend the needle of the meter from pegging the minus end of the scale. But, provided reasonable care is taken in the use of this meter, it will give long and valuable service, and will make your signals more intelligible and appreciated over the air.

The observed reaction of this meter to some common operating practices may be of interest to potential builders and users of the Dialogue Meter. It seems to be especially allergic to three practices: (1) The use of unnecessary amateur abbreviations on phone, (2) Unnecessary repetition, and (3) Stilted wordiness. The first of these allergies does not grow out of the fact that this meter is calibrated on a Broadcasting station, but is in the interest of readability and brevity. It is so much easier and more satisfactory to say "static" than "QRN, with N as in Nebraska" that it is small wonder that the latter gets the gong from the meter. Likewise, "fading," interference," "location," "wait," and others are preferred over the unnecessary and hard-to-catch abbreviations "QSB," "QRM," "QTH," "QRX" and the other "Q" signals. It is downright dangerous to your meter to say "HI" when you really meant to laugh, and the use of "kay," "dah dit dah," "ess kay," and other such childish hang-overs from code operation cause negative readings of eighteen points. Please note, however, that the meter objects only to unnecessary or useless abbreviations, for it gives a slightly better reading to the simple, symbolic, ear-catching clarity of "CQ" than to the unnatural verbosity of "Calling any amateur station."

It must be pointed out here that users of the Dialogue Meter should beware of using the word "handle" when most every one knows the true use of the word "name." For those who absolutely must see the needle wrapped around the pin it is only necessary to utter this phrase: "Well, OM the handle here is . . . ." There would be a few exceptions, however. For example if you were describing an axe handle, or a mechanical device having a handle, the meter would tolerate it.

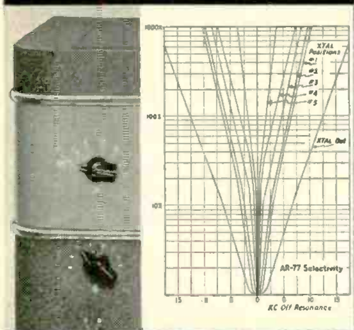
[*Continued on Page 98*]

Dual alignment of r-f circuits provides greater approach to constant sensitivity, higher image rejection throughout each range. H-f end of each coil aligned with Air-Dielectric Trimmer. L-f end inductance tuned.



Electrical bandspread at its best results from use of this special 3-gang, triple-section condenser connected in parallel with the 3-gang, double-section main-tuning condenser. Ceramic insulation used for dependability, strength.

A temperature-compensated trimmer condenser in the h-f oscillator circuit stabilizes frequency from effects of temperature changes. A voltage-regulator tube guards against frequency shifts caused by line voltage variations.



Selectivity is variable in six steps. Curves show degree of selectivity for each step. Note that step #6 has a bandwidth at "two times down" of less than 100 cycles!

AN RCA ENGINEERING ACHIEVEMENT

The few features shown above will give you some idea as to why the AR-77 is one of the finest, most sensitive and most stable receivers on the market today. Space here does not permit the inclusion of other outstanding features ranging all the way from more effective use of insulation to the manually-adjusted Noise Limiter. That is why we suggest that, before buying your new receiver, you see the AR-77, look it over from stem to stern and give its dials a whirl at your nearest RCA Amateur Equipment Distributor's store. You be the judge!

AR-77
Communication RECEIVER

Stay-put tuning; break-in operation; highest signal-to-noise ratio; uniform sensitivity; bandspread tuning for the amateur 10, 20, 40 and 80-meter bands; improved image rejection; negative feed back; antenna trimmer, etc.

Amateurs' Net Price, **$139.50**
MI-8303 Table Speaker in matched cabinet, **$8.00** *extra*
F.O.B. Factory

RCA

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RCA BROADCAST EQUIPMENT
From microphone to antenna

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In Canada: RCA VICTOR COMPANY LIMITED, MONTREAL

What's New . . . .

IN RADIO

BATTERY-OPERATED AIRCRAFT RADIOPHONE

An entirely new type portable two-way, radiotelephone unit has recently been introduced on the market by Electronic Specialty Co., Glendale, California, manufacturer of Ranger aircraft receivers. The new unit measures only 11½ inches in width by seven inches in height, yet it contains the complete transmitting and receiving equipment, dry-battery power pack and a four-inch loudspeaker which is automatically cut-in when the usual head phones are removed or when the receiver is used at an office or home to get weather reports. The Ranger Portable Combination has an average transmitting range of 10 miles and owners report frequent operation over greater distances.

The transmitter is crystal controlled on 3105 kc., and is put in operation with a push button control on the microphone. Instant heating tubes are used, and a relay operated by the push button controls cuts out the receiver filaments during the transmitting period to prolong battery life. The receiver operates on the 200-400 kc. band and the tubes are also instant heating.

Another feature of the Ranger Portable Combination is an antenna change over relay that automatically changes the antenna from the receiver to the transmitter, or vice versa, when the microphone push button is operated. This eliminates the need for separate receiving and transmitting antennae.

There are only 3 controls on the set, aside from the mike push button. One is for receiver tuning, another for receiver volume and the third for transmitter output tuning. An indicator light is used for tuning the transmitter to maximum output.

Weight of the entire Ranger two way radiophone, including the battery power pack, head phones and microphone is only 13 pounds. All Ranger equipment is built under A. T & T. patents.

RADIO FLIGHT INSTRUCTION EQUIPMENT

A new development in ultra-high frequency radio flight instruction equipment was recently announced by Electronic Specialty Co., Glendale, Calif. Two basic units comprise the equipment; the Ranger transmitter for use by an instructor on the ground and the Ranger pre-tuned receiver for use by the student in the airplane.

The advantages of such equipment is that one flight instructor can observe the practice flights of one or more students, and instantly correct them or caution them by radio telephone. Substantial savings in solo time and reduction in flight hazards are claimed by the school using such equipment.

Two types of receivers are built for use in the training planes, both of which are automatically put into operation when the head phones are plugged in; one is a straight receiver operating on the pre-tuned frequency of the transmitter, and the second is a receiver and inter-communication system whereby an instructor in the plane can talk to the student in addition to the student receiving instruction from the ground.

Weight of the receivers is only 2 lbs., 12 oz., and the battery about 5 lbs. Frequencies on which such equipment may be operated are 33,420; 33,660; 37,860 and 39,060 k.c. The range of the transmitters is from 5 to 10 miles so that a relatively large number of them can be operated in any training area without interference.

NEW GENERAL ELECTRIC 866A-866

A new mercury-vapor rectifier, bearing the type number GL-866A/866, has been added to the General Electric Company tube line for amateur and commercial service. Completely interchangeable with present-type GL-866 and GL-866A rectifiers, the new tube makes possible the higher rating of the GL-866A at the price of the GL-866.

The GL-866A/866 has a spiral edgewise-wound cathode with its axis vertical and surrounded by a heat-conserving shield which is at cathode potential. The glass envelope is of the dome type with the anode placed at the lower end of the small portion of the dome. Thus there is a very small space between the edge of the anode and the glass, minimizing ionization at the back of the anode and near the anode lead. The anode lead is also enclosed in a glass "pantleg." The tube has a standard medium four-pin base, and is of unusually sturdy construction.

[*Continued on Page 87*]

Ben says..."the performance of any transmitter is no better than the Class C amplifier...I was very careful in my choice of every unit that went into its construction ... after considering them all, I chose Eimac 75T's and they have exceeded my expectations ... I have loaded them from 150 watts to 1050 watts input and they have come through with flying colors."

At the present time Ben is running the pair of 75T's at 310 watts input. The results obtained with this class C amplifier speak well for the design and performance of the tubes. Right now Ben is converting other sections of his transmitter to Eimac Tubes. There's no stronger recommendation than that. A pair of 75T's going in as doublers.

Eimac TUBES

Eitel-McCullough, Inc. • San Bruno, California

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POSTSCRIPTS... and Announcements

Pittsburgh Area Annual Hamfest

The Annual Hamfest of the Pittsburgh Area Radio Club Council has become the largest indoor amateur event in the district. Last year the attendance was very close to 500. This year the event will be held in the Fort Pitt Hotel, Pittsburgh, Pa., at 8:30 p.m. on the evening of February 15, 1941. There will be several speakers, eats, prizes, and hamfesting.

Rochester Annual Hamfest and Banquet

The Rochester (N.Y.) Amateur Radio Association's annual Hamfest and Banquet will be held on George Washington's Birthday, February 22, 1941. The place will be the Starlight Roof of the Sagamore Hotel, 111 East Avenue, Rochester, New York. "Doc" Smith, W8RGA, will be Master of Ceremonies. Tickets are $2.00 for the banquet which will begin at 7:00 p.m.

Color Television

General Electric recently demonstrated a system of two-color television which proved to be quite satisfactory. The system gave almost as good color reproduction as the recently publicized three-color system, and gave considerably less flicker in the same amount of bandwidth as employed by the three-color system.

Chicago Luncheon Club

After dunking doughnuts together at an informal luncheon nearly every week for several years, W9BNX, W9QDA, W9QHZ and W9OMP have decided to become less "exclusive" about it. An arrangement has been made with Harding's Dining Room on the seventh floor (west) at the Fair Store in Chicago's "loop" to set aside a private room each Monday noon beginning in January, for all amateurs who may care to come. The cost of the luncheon will depend on what is selected from the menu. The minimum charge is only ten

[*Continued on Page 93*]

NEW BOOKS and trade literature

THE METER AT WORK, by John F. Rider, publisher, 404 Fourth Ave., New York City. 152 pages, cloth bound, profusely illustrated with illustrations separated by "split book" type binding. Size 5½ by 8½ inches. Price $1.25 in U.S.A.

The Meter at Work is a practical book for students and those who employ electric meters in radio work. In it will be found simple explanations showing how each type meter works and how each is used. It explains how to get the most use from meters and what points to consider in selecting new meters. All types of repulsion iron meters and D'Arsonval movement meters are covered thoroughly, as are rectifier type a.c. instruments.

An interesting feature of the book is the "split book" type of binding which permits one to view any illustration in the book while reading the regular text; it is not necessary to turn text pages to find an illustration pertaining to a particular text passage.

MOST POPULAR 1940 RADIO DIAGRAMS, compiled by M. N. Beitman, published by Supreme Publications, Chicago. 208 pages, 8½ by 10¾ inches. $1.50 in U.S.A.

Over 80 per cent of all 1940 radio circuits, 417 models of 43 manufacturers, are contained in this book of diagrams. Includes service information, repair hints, alignment data, parts lists, etc. F.M. receivers and home recording sets are included.

Cornell-Dubilier Catalog No. 185A

The new 1941 abridged catalog of capacitors has been announced by Cornell-Dubilier. It is 8½ by 11 inches in size, contains 20 pages, and is printed upon high-grade finished paper. All the various types of mica, paper, dykanol, wet and dry electrolytic, and auto-radio capacitors are completely described in a clear and concise manner. Also described are the various types of capacitor test instruments and capacitor decades manufactured by the company. A page in the catalog is also devoted to a description of the quietone interference filters made by CD. The catalog, which is a worthwhile reference work for any amateur or radioman, is available from your distributor or direct from the manufacturer, Cornell-Dubilier Electric Company, South Plainfield, N.J.

ASTM Standards on Electrical Insulating Materials

The 1940-1941 edition of this publication includes twelve specifications and tests covering flexible varnished tubing, varnished cloth tape (black bias-cut), phenolic laminated sheet, friction and rubber insulating tape, rubber gloves for

[*Continued on Page 95*]

A 500-Watt Commercial Transmitter

[*Continued from Page 15*]

The tank condenser itself is mounted on Johnson stand-off insulators, and it in turn supports the vacuum condenser and inductance. The frame of the variable condenser is used as the mounting for a heavy duty r.f. choke and the latter is connected from the center of the tank circuit to the frame of the condenser. The modulated high voltage d.c. is fed to the frame of condenser, and the leads from the variable condenser to the tank coil are used to support the vacuum condenser. All this results in a final amplifier which has very little wiring and which tests show to be effective on frequencies from 1500 kc. to 40,000 kc. Included in the diagram of the transmitter proper is a circuit for a suitable speech amplifier. This equipment is rather conventional except that an audio oscillator is built into the unit. Actually it is located on the operating desk and not in the transmitter. The diagram is self-explanatory.

Suggested Changes for Amateur Use

As was previously stated, this transmitter was originally intended to be used for commercial work. Some changes may be advisable if the equipment is to be used in amateur service, in addition to the change in the exciter previously suggested. By increasing the d.c. plate potential from 2300 volts to 3000 volts, the power input could easily be raised to a kilowatt. The reliability of these transmitters is excellent. Several units, including the one shown, are now in commercial service and their performance leaves little to be desired.

See Buyer's Guide, page 96, for parts list.

Peaked Audio Amplifier

[*Continued from Page 26*]

signal would go up and the noise remain the same, or the signal remain the same and the noise drop. A compromise, in which the signal goes up somewhat and the noise drops appreciably, was decided upon after several tests.

When tuning over the band for c.w. signals with the filter cut out, it will be necessary to adjust the heterodyne pitch very close to the "resonant" frequency of the filter before cutting in the filter, if loss of the signal is to be avoided when the filter is switched in. (Yes, the filter is *that* sharp.) At first it will be necessary to retune quite often when cutting in the filter, but after one becomes accustomed to the pitch of the filter retuning seldom is needed.

For a frequency of slightly less than 600 cycles, the following method will assist one in predetermining the filter pitch when tuning for c.w. signals with the filter cut out, before one has the filter pitch firmly fixed in his subconscious: Adjust the pitch of the signal until it is just perceptibly higher than the lowest pitch which you can whistle comfortably. Then cut in the filter. If you haven't missed by an octave, you should score a bull's eye.

See Buyer's Guide, page 96, for parts list.

New Tubes

[*Continued from Page 48*]

ample friction to hold the base in its socket. The high power sensitivity of the 1625 makes it especially useful in frequency-multiplier service where high harmonic output is essential. It may also be used as a crystal-oscillator and buffer amplifier in medium-power transmitters with an input up to a half-kilowatt. The 1625 can be operated at maximum ratings at frequencies as high as 60 megacycles and at reduced ratings at frequencies as high as 125 megacycles. Its maximum plate dissipation rating is 30 watts (ICAS).

THE 1626 12.6-VOLT 5-WATT TRIODE

The 1626, a transmitting triode of the indirectly heated type with 12.6-volt heater, is designed especially for r.f. oscillator service in applications requiring unusual stability of characteristics. The maximum plate dissipation is 5 watts. The 1626 may be operated at maximum ratings at frequencies as high as 30 megacycles, and at reduced ratings at frequencies as high as 90 megacycles. Because of its 12-6-volt heater rating, the 1626 is particularly suitable for use in aircraft radio transmitters.

THE 3S4 BATTERY-RECEIVER PENTODE

Another new tube that has just recently been announced (receiver type) is the 3S4 pentode. It is intended for use in the output stage of light-weight a.c./d.c./battery-operated portable equipment. This new tube has essentially the same characteristics as the miniature type 1S4 but is designed with a filament having a center tap to permit of either a series-filament or a parallel-filament operating arrangement. The series arrangement requiring only 50 milliamperes has been provided especially for equipment utilizing a source of rectified power for the filament supply.

Aurora U.H.F. Propagation

[*Continued from Page 22*]

exist in or near the immediate auroral zone.

We accept the fact that there would be rapid variations in the number of paths the signal could follow to reach the receiving position. This would result in random in and out of phase effects causing severe wave interference fading and possibly, also, changes in the audio frequency output similar to a form of selective fading. However, it appears that the application of the principle of Doppler's effect may be an answer to the extraneous and muffled sound effects that are as much a part of auroral dx as the aurora itself.

Doppler's Effect

Doppler's effect is well known in physics as the shift or change in *observed* frequency from that originating at the source. It would, in radio analogies, be brought about by the reflection of the radio signal from a plane surface, or refraction of the signal through media, either of which was in motion, approaching or receding from the receiving position. This is explained by the simple reasoning that if the reflecting medium was approaching the receiving position there will be received more complete cycles than if all factors were stationary. Conversely, if the reflecting or refracting medium was receding, then a lesser number of complete cycles would be received than if all factors were stationary. This effect causes frequency modulation of the carrier in accordance with the shifts in the auroral reflecting media. Naturally this auroral frequency modulation of the carrier can be heard at the output of the receiver.

Periodicity

The possible prediction of aurora outburst seems to have the same status as prediction of sunspots. Undoubtedly a very close corelationship exists, but at the present time predetermination is still in the realm of generalities.

It has been more conclusively shown that the maximum of outbursts does occur during the months of March and September, while correspondingly fewer storms of this nature are noted either around June or December. The months of March and September are already well known in our minds as the times of the vernal and autumnal equinoxes, when the earth is more in the line with the sunspot zones.

Surprisingly enough it has also been shown that a correlation can exist on the basis that more frequent and more severe storms occur in the northern hemisphere when the moon is below the earth's equator—facing our southern hemisphere. This might be more than just coincidence, since it is plausible that the moon is intercepting a strong portion of the emanation from the sun which would otherwise strike, or rather be pulled into, the earth's own magnetic field. This may hold the key to periodicity of ionosphere storms, according to many authorities.

That 5 and 10 Meter Skip

[*Continued from Page 44*]

due, presumably, to the strong ionization that day. This could be called "shorter skip" and commonly is, but is no shorter for signals out to the 1250 mile approximate limit. By "shorter skip" we more often mean that many more stations at shorter distances are heard, although nearly the same number may come through from the longer distances.

With a complete change to stabilized transmitters and widespread use of selective superheterodyne receivers, contacts seem to have become possible recently under conditions that were probably too poor to result in dx contacts with earlier equipment. Very likely, this has resulted in many long contacts especially in 1940, when very few stations came through. Sometimes, W5AJG in Dallas could work W1DEI near Boston, W1HDQ near Springfield, Mass., and W2MO or W2TP when other stations did come through. The distance from Dallas to Boston has been calculated as 1551 miles, of which perhaps 300 miles have been covered with the assistance of low atmosphere bending at one or both ends, allowing longer distances to be covered. On most of these days, there were no signals from around the half-way point, which would have given weight to a theory that more of the 1551 mile contacts were made by two hops of less than 800 miles.

Both the Sporadic-E ionosphere records and 56 Mc. reports of skip dx are largely concentrated in the months of May through August each year, but there are often one or two good days a month even in the winter when amateurs now make dx contacts, and the ionosphere measurements agree. Sometimes the sporadic-E condition occurs in the early morning hours when practically no amateurs are on hand to make use of it.

28-Megacycle Comparisons

If a signal is received from a transmitting station 1200 miles away via one ionosphere reflection, the point of reflection is about midway between, or 600 miles from the receiver. If the same layer condition extends from the

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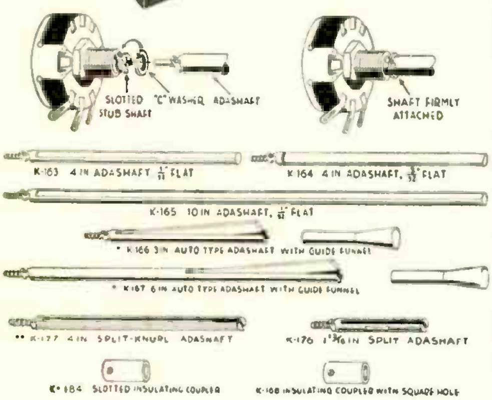

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250,000	ohms	6
500,000	ohms	6
1 MEG	ohms	6
2 MEG	ohms	6
3 MEG	ohms	6
250,000	ohms	tapped
500,000	ohms	tapped
1 MEG	ohms	tapped
2 MEG	ohms	tapped

SHAFTS
3 K163
2 K164
1 K165
1 K166
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point of reflection toward the receiver, then lower frequencies such as 28 megacycles should be heard at shorter distances also. This connection between 56-megacycle reception and that on lower frequencies has been observed by several of the reporting amateurs, and was used considerably at W5EHM either to indicate that 56-megacycle communication might be possible, or to contact a station on 28 megacycles to request that the operating frequency be doubled.

It may not always be possible to notice this connection on lower frequencies with what has been considered to be sporadic-E-layer 56-megacycle transmission because, while communication is usually possible over the same distance on lower frequencies, sporadic ionization may be confined to a relatively small geographic area, thus not necessarily permitting shorter hops to be observed from the same receiving station.

Conclusions

The relationship between 56-megacycle communication or summer 28-megacycle work and sporadic-E-layer reflections measured at Washington, together with the apparent identity of the maximum observed distances with those expected from a layer situated at the E-layer height, tend to confirm the theory that communication at this frequency over a distance of 400 to 1250 miles takes place via sporadic-E-layer reflections.

The data are not yet sufficient to indicate whether a given condition travels west with the sun or remains fixed geographically until it disappears, though the phenomenon may be more complex than either of these assumptions. The answer to this question may be found with 56-megacycle transmissions and ionosphere measurements at more locations.

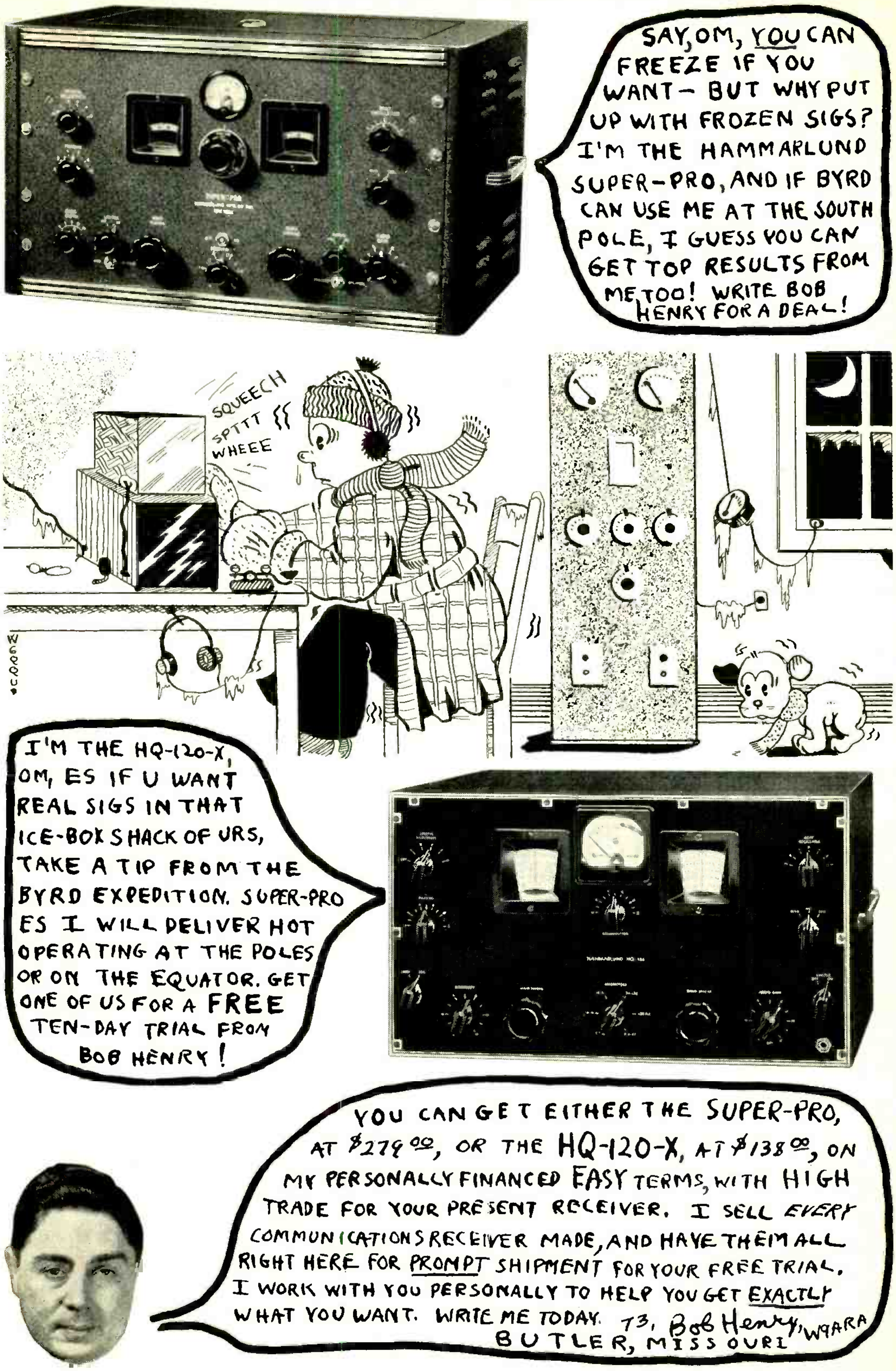
Broadside Close-Spaced Arrays

[*Continued from Page 37*]

for maximum front gain, the proper adjustment of lengths will be reached.

This should be followed with the adjustment of the deltas by the minimum standing wave method as follows: First, the deltas should be adjusted for minimum standing waves as indicated by a meter or neon bulb being moved along the open wire lines between the antennas and the matching box. For further details one should refer to the RADIO HANDBOOK. Then, with the deltas properly adjusted, the tap that the concentric line makes on the matching coil should be varied to produce minimum standing waves on the concentric line. Testing by the usual neon bulb method will be fruitless because the field outside this type line is, theoretically at least, zero. However, a quarter wave of concentric line added between the transmitter and the matching box should make no difference in the reading of an ammeter inserted in the center conductor somewhere along the line if there are no standing waves present. Any appreciable amount of variation in current, everything else remaining constant, indicates standing waves. A suggested setup is shown in figure 8. Two adjustments may be made to eliminate standing waves: (1) vary the delta and (2) vary the tap on the coil made by the center conductor of the concentric line.

Just a word of warning: in the setup used here, when the length of the A's are varied the distance spanned by the deltas is also varied. This must be compensated for by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SQUEECH
SPTTT
WHEEE
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YOU CAN GET EITHER THE SUPER-PRO, AT $279.00, OR THE HQ-120-X, AT $138.00, ON MY PERSONALLY FINANCED EASY TERMS, WITH HIGH TRADE FOR YOUR PRESENT RECEIVER. I SELL EVERY COMMUNICATIONS RECEIVER MADE, AND HAVE THEM ALL RIGHT HERE FOR PROMPT SHIPMENT FOR YOUR FREE TRIAL. I WORK WITH YOU PERSONALLY TO HELP YOU GET EXACTLY WHAT YOU WANT. WRITE ME TODAY. 73, Bob Henry, W9ARA
BUTLER, MISSOURI

moving the points at which the deltas connect to A's when their lengths are changed. Naturally it is imperative that corresponding elements in each portion of the array be kept the same length so that proper balance between the two may be maintained.

Results

The double-four vertical rotary beam yields a gain comparable to a four-wavelength-on-a-side terminated rhombic, and with a wider vertical angle of radiation. Air reports over W5CXH showed that too much had not been expected of the antenna, for indeed there was appreciable gain over the ordinary horizontally-oriented three-element beam. For domestic contacts the gain over the three element averaged about 1½ R points, with noticeable improvement in consistency. For foreign contacts the gain was about 2 R points over the same reference antenna. As for foreign consistency, stations repeatedly reported us as the first signal in and the last signal out, with noticeably more punch and "solidness," and somewhat less fading.

The array is very critical as to frequency if good front to back ratio is wanted; however, the forward *gain* will still be quite good even 150 kilocycles off frequency at ten meters. A height of 35 feet was used for the center of the array.

Possible Modifications

If one should be ambitious enough to want to put more elements on a beam of this sort, or any sort for that matter, it was this experimenter's experience that: 1) after adding the second director spaced at .1 wave, there is no advantage in spacing any closer than .25 wave, 2) that a third director spaced at .25 wave is just as gainful as third and fourth directors spaced at .1 wave. After two directors the increased cost and weight is not offset by enough increase in gain to warrant any additional ones. If more than one reflector is used, the inside one should be tuned for maximum front gain, and the outside one for minimum back radiation. The same rule should be followed in spacing of reflectors as directors.

Conclusion

It would be wise in building this antenna for twenty meters to design a more substantial structure to support the elements, for though the structure described here suffices for "ten," the frame would have to be heavier material for the twenty meter array. The tuning procedure is rather involved and took the writer several days to complete, and there is no point in going to the trouble and expense of putting up such an array unless the constructor plans to devote several days to careful tuning. If the antenna is put up much higher than thirty-five feet, the domestic signal is likely to have excessive fading.

With so many fancy antennas around to befuddle and bewilder the amateur, perhaps we should wind this up with that recommendation of Confucius, "When in doubt, use a long wire."

So?

An electronic Wheatstone bridge of such sensitivity has been described that the instrument will automatically and continuously indicate the insulation resistance of the panel if the latter is of a "poor" insulating material like bakelite and the "unknown" terminals pass directly through it.

1941 "RADIO" HANDBOOK

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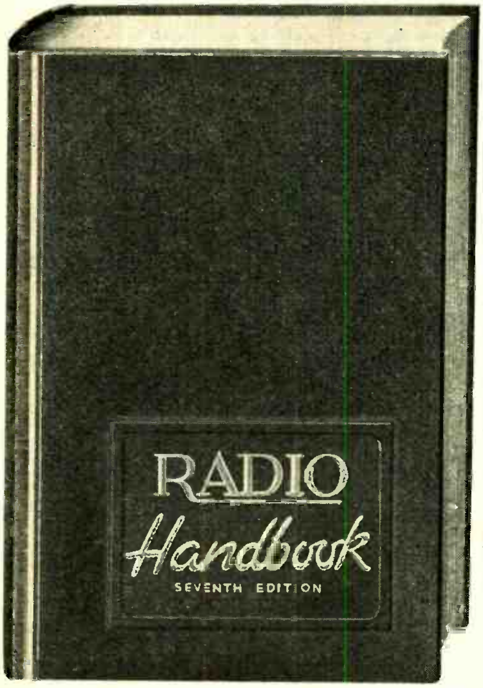

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Terminating Antenna Feeders

[*Continued from Page 31*]

modate the usual two-wire transmission line (400 to 600 ohms). The inside of the box should be given several heavy coats of paint, and the exterior should be dosed well with creosote, tar or many coats of paint, to prolong the useful life of the wood. The top side of the box is hinged, to provide accessibility to the transmission line. The principal objection to this installation is that it is necessary to uncover the top of the box each time a change or inspection of the line is required. This should not be too much of a drawback, however, since it would seem unlikely that the line would be inspected more than twice or three times a year.

A decorative manner of covering the box—and one which makes much simpler the uncovering and inspection of the line—is to make a path of brick over the line. Other possibilities will undoubtedly occur in an individual case, but, in any event, don't make the mistake of letting the x.y.l. plant a flower bed in the freshly upturned earth at the time of installation. If the line is laid below sod, it might be wise to place reference pegs at the width of each end, so that at the time of some future exhumation, the "body" will be located with a minimum of sod wrecking.

The sketch of figure 9 illustrates how a twisted pair feeder may be run through a length of pipe to accomplish the same purpose previously described. Since a twisted pair usually terminates at the center of an antenna, the post in this case need be sufficiently high to place the twisted pair out of arm's reach. This immediately suggests the feasibility of using the same idea for a two-wire open line feeder in the same manner. In the case of the open line terminating at the center of an antenna the post of figure 9 would be replaced by a rectangle, hollow on the inside, made up of strips of 1 x 6's, or of such dimensions as may be required by the particular line to be used. If a "zepp," rotary or any end-fed antenna is used, the hollow shaft is placed adjacent to the supporting pole.

It must be remembered that there will be considerable condensation of moisture in the methods portrayed by figures, 7, 8 and 9. Plenty of clearance should be allowed in the construction of the box, to provide for leakage by moisture. In the case of the concentric line, if not under gas pressure, it should at least be sealed at both ends—although in a line of relatively short length, under ordinary conditions of humidity and temperature variations, a lack of seal or gas will not produce an intolerable loss.

In the sketch of figure 9, the twisted pair line should be the *best* since condensation may form a considerable amount of water over a given period of high humidity and temperature changes. It might be suggested that the transmitter end of the line might be somewhat lower than the antenna end, so that any appreciable amount of water will drain into the operating room. Lest you become alarmed, it is now suggested that a small container be placed at the end of the pipe, in which the water might drain. The top of the pipe should be appropriately sealed or covered in some manner, so that rain or snow cannot enter.

This also applies to the suggestion for the open spaced two-wire line through the hollow rectangular "post."

Special tools for basement installations consist only of a star drill, which is necessary to drill a hole through a concrete wall in the event it is not desired to use window facilities.

Economics

None of the methods described require a large cash outlay. Stand-off and feed-through insulators are cheap, as is masonite and wood. The most costly item will likely be the cutting of glass for the permanent installation of a panel in a window sash. The simple carpentry and painting required is well within the ability of the average amateur. Therefore, cost should not be the principal deterrent to the installation of neat and effective feeder terminations.

How Do You Do It?

There are undoubtedly in existence a number of variations from the previously described methods, and also many which have not been discussed here. The EDITORS of RADIO will be glad to publish photographs of antenna installations which indicate the exercise of ingenuity or originality by the owner.

Versatility in a 100-Watt Transmitter-Exciter

[*Continued from Page 19*]

inum. Its construction can be seen quite well in the top view of the rig. The fixed plate is supported by the two stator lugs of the tuning condenser and the plate itself is given a double bend. The exposed size of the plate is 1 by 2 inches. The movable plate is bent in an "L" shape and is supported by the feed-through insulator that goes from the switch S_5 to the grid of the tube. The adjustment of the neutralizing condenser is easily varied by rotating the plate attached to the grid; when the proper adjustment for neutralization is found, the plate can be locked in this position by tightening the upper nut on the feed-through insulator.

Mechanical Construction

The unit is designed for rack mounting and is constructed on a standard 10 by 12 by 3 cadmium-plated chassis. The chassis is turned with the 10-inch width toward the panel since the speech amplifier is to be placed alongside the exciter chassis and both are to be supported from a 19-inch panel. All five of the exciter tuning condensers are mounted behind the panel and adjacent to the coils with which they are associated. Extension shafts connect to the knobs on the front panel. The five knobs which rotate these condensers can be seen in the front-view photograph of the unit. Below these knobs are mounted the four switches in the cathodes of each of the 6L6 stages. In the center of the chassis, with two cathode switches on each side, is the switch which selects the stage from which excitation to the 35TG is to be taken. This selector switch is mounted behind the panel with an extension shaft in the same manner as the exciter tuning condensers.

The two sockets in the grid and plate circuits of the first 6L6 stage are mounted on the rear of the chassis. Three-inch coil shields are placed over each of these sockets so that the coils or crystals which are inserted in them will be fully shielded from any external field. All filament and plate voltage connections to the exciter transmitter (except the 1250 volts for the 35TG plate) are brought out to an octal socket on the rear of the chassis. The 1250 volts is connected to a feed-through insulator.

See Buyer's Guide, page 96, for parts list.

A.C.-D.C. Vacuum-Tube Voltmeter

[Continued from Page 34]

switch S_1 is in its lowest position the voltage under measurement is applied directly to the grid, giving maximum sensitivity. With a 0-1 milliammeter at M, one volt d.c. at the grid will give full-scale indication; voltages down to .05 volt may be read quite easily on this scale. The additional multiplier resistors R_2, R_3 and R_4 allow full-scale indication at 10, 100 and 500 volts. The input resistance remains constant at 100,000 ohms per volt on all ranges.

To measure a.c. voltages the "A.C." terminals are used. The a.c. voltage is rectified by the 6SQ7 diodes and applied across the grid-cathode circuit of the triode section as a d.c. voltage. Resistors R_2, R_3 and R_4 form the load circuit for the diode rectifier, while the input circuit is completed through the source of a.c. voltage under measurement.

For a.c. measurements, the v.t.v.m. has the same ranges as for d.c., but the *peak* values of the half-cycles are indicated by the meter. In most cases sine-wave a.c. will be measured, so the r.m.s. a.c. voltage will be given by multiplying the meter reading by .707. The full-scale r.m.s. readings for a.c. are .7, 7.07, 70.7 and 353.5 volts on the four ranges. The a.c. input impedance is approximately one-half the d.c. resistance, or 50,000 ohms per volt.

To eliminate the effects of electrostatic pick up from the power supply and nearby a.c. lines on the 10-volt scale, it was found necessary to include a 0.1 μfd. by-pass condenser between the junction of R_3 and R_4 and ground.

Power Supply

The power supply is a simple affair employing a small b.c. type replacement transformer and a resistance-capacity filter. The filtering action is aided by the two voltage regulator tubes. These tubes hold the plate voltage constant at 255 volts, thus improving the accuracy under changes in line voltage.

Construction

There is little that need be said about the construction of the unit, since the location of the components is not of great importance. As may be seen from the photographs, however, the power supply and voltage-regulator section is located at the rear of the chassis, while the 6SQ7 and its associated circuits occupy the section nearest the panel. The three input terminals are located at the lower right edge of the panel, with the power switch in a corresponding location at the left. The knob to the right of the meter operates the range-change switch, while the other knob is for balancing the meter bridge circuit. The cabinet measures 10 by 7 by 6 inches, and the chassis is 9 inches long and 5½ deep.

Initial Calibration

Before attempting calibration, the v.t.v.m. power supply should be turned on and the meter adjusted to read zero by means of R_9. As the 6SQ7 warms up, the meter reading will change somewhat, but a stable condition should be reached in two or three minutes. After the unit has been warmed up, the range switch should be set to the 1-volt scale and a d.c. voltage of one volt applied to the d.c. terminals. The correct voltage may be obtained from a 1.4-volt flashlight cell by means of a potentiometer, an ordinary d.c. voltmeter being used to determine the correct setting of the potentiometer. If all goes well the meter will read exactly full scale with the one volt applied. If the meter should read too high or too low the value of R_6 should be changed slightly, R_9 reset for balance with no input voltage, and the 1-volt indication again checked. The value of R_6 is not extremely critical and it is quite probable that the value specified under the diagram will give satisfactory results.

After the instrument has been calibrated on the 1-volt scale no further calibration is needed, if the multiplier resistors for the other ranges are accurate. There is one type of measurement for which the v.t.v.m. *cannot* be used—it will be found impossible to get a correct reading on the 120-volt a.c. supply line, since condensers C_4 and C_5 place the chassis effectively at the center of the a.c. supply voltage, causing an incorrect reading.

See Buyer's Guide, page 96, for parts list.

The Amateur Newcomer

[*Continued from Page 66*]

and two additional leads are used back to the second. This avoids the "special" character of interconnecting leads and more nearly approaches a "standard" hook-up.

High voltages that are too much for the cabling system can be handled separately, with safety precautions observed. The usual standoff insulator, with a rubber sleeve to go over the soldering lug and nuts, can be mounted on each chassis, but preferably *under* the chassis on decks above the lowest so that the terminal, if accidentally exposed, will be out of reach.

The grounded side of circuits can run through the metal rack without copper wire connections, if desired. There is something to be said for not grounding the negative (or bias supply positive) to the chassis but, nevertheless, of connecting the chassis to ground, to reduce the possibility of getting across *both* the negative and positive high voltage. This is a safety measure only if the microphone stand, while grounded, is *not* also connected to the negative high voltage through some roundabout way.

The several eight conductor cables needed in this inter-connecting system can run directly from one chassis to another, or can be kept out of the way by mounting a hook or bolt protruding from a rear corner of each chassis, behind which the cable can be looped to hold it to one side. In fact, there is reason to doubt the wisdom of putting the connectors on the back of a chassis anyhow when they can be placed more conveniently on the top surface of a chassis along one edge.

R.F. Circuits

Links carrying r.f. from one chassis to another are still best handled on concentric line or spaced open-wire line rather than on twisted pair or run in the interconnecting cables, especially on the highest frequency bands. These links can be plug-in. The same methods can be followed, of course, in the antenna circuit. If an antenna change-over relay is used, the field current can be taken off at the operating table switch panel or in the rack itself, wherever convenient, if an outlet has been provided. Generally, such an outlet will be connected after the high voltage toggles rather than after a filament switch, so that only this one switch need be thrown to transmit, if the filaments have been kept on.

While every conceivable interconnection may not have been covered in this discussion, the basic ideas probably can be applied. After more experience has been gained, it may be possible to obtain the cooperation of manufacturers in following a standard arrangement for outlet wiring, just as in the old days of four prong plugs in receiver power supplies.

Past, Present and Prophetic

[*Continued from Page 9*]

we'll just remind you that the "fever" season is near. To a radio man, that means one thing: new antennas or fixing up the old ones. In short, to make the few remaining Winter nights more interesting, we suggest you absorb some of Mr. Espy's dissertation on "Broadside Close-Spaced Arrays," page 35.

Amateur Stations

On page 53 of this issue will be found pictures of amateur stations. Do you like this feature? If so—or if you don't—please drop us a card.

Something Good!

An *exclusive* scoop, the Dialogue Meter described on page 67 should be the answer to many a long-suffering recipient of phone QSOs. If *you* have suffered, build this amazing badget and send it to the most needy phone man; the claimed results are well worth the cost donated.

•

*Radiodditi*es

The RCA 813 tube has the first of the *large* 7-pin bases. The socket formerly called large-7 in the catalogues has always correctly been a *medium*-seven.

The newest high-class u. h. f. insulators contain atomic carbon!

What's New in Radio

[*Continued from Page 70*]

The rating of the new tube is: filament voltage, 2.5 volts; filament current, 5 amperes; maximum inverse peak plate voltage, 10,000 volts; average plate current, 0.25 ampere; maximum instantaneous plate current, 1.0 ampere.

IMPROVED STELLITE AND SAPPHIRE RECORDING NEEDLES

Audio Devices Inc., 1600 Broadway, New York City, announces a new and considerably improved line of cutting styli for the critical recordist. More careful inspection and a new manufacturing procedure coupled with scrupulous adherence to detail has produced a stylus with a noise level several db quieter than ever before. The high frequency response is definitely improved and is of considerable interest to studios and broadcast stations now using the newest type of extremely wide-range cutters. For convenience in operation the thread throw has been increased and improved.

Heretofore sapphire and stellite Audiopoints have been individually "recording tested." New tests have been devised to insure the new features of these styli as well as to assure delivery of a truly reliable cutting point.

10-CHANNEL MARINE RADIOPHONE

Hallicrafters, Inc., has added to its line of marine radiophones the "Seagoing" Model HT-12, a 50-watt unit which combines wide operating range with the utmost in operating simplicity. Receiving and transmitting channels, ten of each, are crystal controlled to eliminate manual tuning, and manual switching is avoided through inclusion of a voice-controlled automatic relay system.

A corrosion proofed metal case, 20 inches square by 12 inches deep, houses both the transmitter and receiver sections. On its front panel are arranged the few simple controls, the telephone handset, a built-in loudspeaker and a meter which provides a visual check on transmitter operation. The power supply is a separate unit and is available in two types, one for direct operation from a 12-volt ship's battery, the other from a 110-volt a.c. source. This latter type also serves where the supply is either 32 or 110 volts d.c., a rotary converter being utilized to adapt it to these supplies.

With the receiver channel selector switch set for the channel of the nearest shore telephone station (or for the ship-to-ship channel) the owner can keep in constant touch with what is going on and will hear calls intended for him. In addition, provision is made for connection of an automatic bell ringer which will ring only when his boat is called.

The receiver is a sensitive and selective 7-tube superheterodyne with one stage of preselection, built-in i.f. wavetrap and highly effective a.v.c. and q.a.v.c. systems.

Universal Microphone Co., Inglewood, Cal., in January discontinued the manufacture of all of its recording machines, with the single exception of the professional model. It will also continue to produce the recording chassis job for manufacturers and jobbers.

SMALL ELECTRIC HAND DRILL

Paramount Products Co., 48 West 48th Street, New York, N.Y., announces a small portable electric hand tool which should be of interest to radiomen who are doing construction work. The tool is quite inexpensive and comes in two models: the standard model with triple gearing down to the chuck, and the two-speed model which gives this speed and a very high speed for sanding, grinding, engraving, etc. The unit has a ball thrust bearing, operates from a.c. or d.c., and has a large cooling fan built into the motor. The frame is die-cast alloy and the brushes are easily available from the outside. A three-jaw coil-spring universal chuck will take any shaft or drill up to 1/4" diameter. The unit is very compact, has a pistol-grip handle, and weighs only 3½ pounds.

With the Experimenter

[*Continued from Page 57*]

are a 6AD7-G, a 250,000-ohm ½-watt resistor, a 500,000-ohm ½-watt resistor, and a .05-μfd. tubular paper condenser. Proceed as follows:

If no. 1 pin is grounded, disconnect the ground. Remove the wire going to no. 5 pin and connect to no. 1 pin instead. Connect the 250,000-ohm resistor from no. 4 pin to no. 6

pin. Connect the tubular condenser from no. 5 pin to no. 6 pin. Connect the 500,000-ohm resistor from no. 5 pin to ground.

The 6AD7-G draws .85 ampere on the heater; however the additional current is not great enough to cause a noticeable increase in the heating of the power transformer, even if it is already being run at maximum rating. The additional plate current drain is less than 1 ma.

The foregoing instructions assume that bias for the output tube is derived from a cathode bias resistor. If bias is derived from a tap on the speaker field (in other words, if the cathode of the tube is connected directly to ground), then the 500,000-ohm resistor should be connected from no. 5 pin to the tap on the speaker field instead of to ground.

X-DX

[*Continued from Page 52*]

like it was before. W1KHE, W1APA, W1AAO are heard frequently on 7 mc., giving a good account of themselves. W6VB has moved into a new spot. W6HJT blew into town for the Rose Bowl game. Stanford won, of course, which meant you couldn't find HJT for 3 days. He finally was located back in Palo Alto. W9EKY and W9RCQ still punching the brass every now and then on 40 . . . their old pal W9KEH now working in Detroit. W9SJD and W9DIR both on a lot, which speaks well for Wisconsin. Where's 9RBI now days?

The column this month is probably the shortest I've ever put through the mill. I hope that we'll have more material next month and this includes photos as well as news items about the gang. I want to thank you fellows for the swell cooperation during the past years. Whether this column continues or not is more or less clutched in the fingers of fate, I'll do my best to keep X-DX going, and I want you to know that it surely has been mighty fine working with all of you. You have helped in making a swell, great big DX family. In any event don't forget that the W9s are increasing every day, and wherever you hear a W9, ol' W6QD won't be far away.

U. H. F.

[*Continued from Page 62*]

as strong as the vertical four-in-phase, but with more fading. The vertical is best on the receiver. A long horizontal at FDA is inaudible at OKC. The moral of this story seems to be, "It Pays To Experiment!" W8RGC is a new contact for OKC.

Friday Night Relays

W8OKC says that W1HDQ, W2AMJ, and many others are trying to line up a relay from Boston to Chicago and St. Louis to operate every Friday night this winter. Give the boys a hand, fellows, even if you are as far south as Maryland and Virginia—the gap across New York is still there, and the one in Pennsylvania may not yet be closed on a "home station" basis.

Now that W9YKX in Woodbine, Iowa, has joined the ranks of the tested and true ground-wave dx'ers, he is ready to take on some schedules with ten-meter harmonics and five-meter fundamentals of stations in Iowa and states bordering thereon. Let us hope that this column will assist in disseminating such information, to the benefit of those who want to know who within 200 miles or so will provide possible u.h.f. dx contacts. Unless there are more dx schedules to keep them busy, YKX, TTL and FZN may jump down to 1¼ to give that band a try.

W9ZJB has been up his pole with a flashlight until ten p.m. and after 5 a.m., trying to get all of the bugs out of his new location. And we don't mean that he has termites in his mast or belfry. He just wants vertical and horizontal rotaries for 2½, five and ten, with a few miscellaneous other antennas.

ABOVE 112 MEGACYCLES

W1KXK in Newmarket, New Hampshire, says that his best 2½-meter dx is 81 miles to W1MNK/1 on Mt. Washington. KXK's antenna is a vertical H with reflector. The transmitter is a pair of HK24's taking 60 watts. For a receiver he has a 955 detector plus lots of audio.

The highest frequency report comes from W2KDB who on 401 megacycles (what is the "one" for?) worked W2TY who is 2¾ miles away. KDB uses a HY615 with 1.3 watts input, feeding three vertical half waves in phase that were later replaced with a square corner beam. The receiving tube is a 955 with a ¾-wave vertical antenna. TY uses a W.E. 316A taking four watts and feeding a vertical half wave. His receiver also uses a 955 acorn but works into—or out of—a widely spaced three-element array. In both cases, the equipment and antennas are in the attic.

W5AJG says that there are the makings of a 2½-meter net in Dallas, if it doesn't peter out before it gets started.

L. V. Broderson, W6CLV, has been on 112 megacycles for half a year or so without hearing anyone even from the top of every mountain within 25 miles of Salinas. So, once a month or so he drives to San Francisco to get in about a dozen contacts. He has one of Woody Smith's transceivers using polystyrene sockets, longer tank leads and a bit tighter coupling, that has given him several R8 and R9 contacts at 30 to 40 miles. On January 1 he started up on 224 megacycles and is open for

Saturday afternoon schedules with others within 50 miles.

Last November 24, W6NJJ on Mount Lassen worked W6NJW on Mt. Diablo with QSA5 R8 reports, a distance of 175 miles, on 112 megacycles. Both used HY75 oscillators with about 15 watts input. W6OVK SLO are now trying 2½ meters in Tucson. W6QLZ received a visit from W6OIN MKS and worked 2½ out to about 40 miles. QLZ says that his new turnstile works very well.

W9ALE in Chicago plans some 2½-meter FM soon, with a coaxial line tuned receiver. W9PNV hooked W9CBI for his 45th contact on the band. CBI is now able to work SIO. DZL in Berwyn is on with a Yagi 42 feet high on four-by-fours but he has to work out a rotating system that will handle the weight. After PNV's twenty-meter beam blew down, the aluminum rods were put to good use on 112 megacycles in a vertical stack of four extended half waves, 22 feet over-all. The three phasing stubs are each 14½ inches long. The feed line hooks on the center stub four inches from the shorting bar. He now gets better reports from all directions. He worked W9OFV in East Gary, 35 miles away, on December 8. Although the contact was 100 per cent on two occasions, there are indications of fading at this distance. LRT and LRM on Chicago's north side heard OFV R4 but he faded out. OFV heard LRT and GPQ. Some of the others active around Chicago are W9WL, W9HOW, W9KJV in Cicero, W9MAT in LaGrange.

W9YKX TTL FZN in western Iowa are about to try 224 megacycles, as mentioned above. ZJB north of Kansas City is still pleased with his new location; until W9ZD's transceiver went sour, Vince used it on a six-element horizontal beam in his room to work W9DDX in Independence, 17 miles away, with R6 and R9 reports. The beam has a reflector and four directors, the radiator being a multi-wire doublet fed with a 1½ inch line. It is quite sharp.

Question and Answer Department

Question: My new plumber's delight beam gives no evidence of tuning up properly when the reflector and director are adjusted. Changes in these elements cause variations in amplifier input and also in the point of resonance on the final tuning condenser. Have you any suggestions?—W5TW.

Answer: First, be sure that you have a horizontal doublet on the field strength meter that is not working against ground, so that it does not operate on vertically polarized feeder radiation. Couple the transmitter lightly to the feed line so that adjustments will not cause large variations in output. Be certain that the transmitter itself is not being picked up strongly by the f.s. meter. If necessary, use the pipe-and-wire arrangement of a two-wire doublet on the radiator to reduce tuning effects upon the resonant frequency and radiation resistance of the radiator itself. Then proceed with the adjustment of the parasitic elements in the usual way.

Question: Is there any way to receive c.w. signals on a superregen receiver?—W8OKC.

Answer: With some adjustments, the s.r. receiver has birdies that permit c.w. to be copied. Presumably, a heterodyne oscillator at the signal frequency will be more satisfactory, however, if it does not put too much oompf into the detector, and if the transmitter is reasonably stable.

Question: Can the "pot oscillator" be used as a sensitive 112 megacycle receiver?—W9PNV.

Answer: It can be used, but there is always considerable doubt that standard tubes can turn out as good a signal to noise ratio at ultra-high frequencies as acorn and HY615 types built for the purpose. Also, the "pot" is not the last word in getting the benefits of coaxial lines—as discussed above.

Question: I am afraid of blowing my 954 (in receiver) while transmitting, if it is left on. What is the best way to protect it so that it can be left on?—W9YKX.

Answer: One way that works in an r.f. stage or in a detector that is neither oscillating nor has r.f. injected into it, is to provide a grid leak of high resistance in addition to the usual fixed or cathode bias. A strong signal will then block the tube. Other means of increasing the bias during transmission or of putting a low-capacity neon tube across the input circuit also should work. A meter showing cathode current will quickly indicate the efficiency of the method that you finally adopt to keep the current from rising and harming the emission when the transmitter is on.

We wish to thank the many who sent us Christmas cards this year. Some carry photographs of the stations or antennas, and will be reproduced here next month if possible.

●

The 28-Mc. Band in Britain

By NELLY CORRY, G2YL

For the first eleven days of October it looked as if the DX heard in September had only been a "flash in the pan," but conditions improved considerably later on, and W's were logged daily (except on October 22), to the end of the month. The general impression was that signal strengths were lower, QSB more pronounced, and the band open for shorter periods, than in October, 1939.

During October, signals from Oceania, Asia and Africa were not heard, and only a few European commercial harmonics were reported —EAK, FZM, IRX and three or four Russians.

The only South American amateur heard was PY7VB, logged at 15.28 g.m.t. on October 12; incidentally, he is one of that now almost extinct species, the 28 megacycle c.w. ham. LSA and LSA2 on either side of the band were heard by G4MR on 21 days during the first 26 days of the month, so probably the lack of amateur signals heard from this continent is mainly due to reduced activity. Most of the South American hams' pre-war 28 megacycle QSO's were with Europe and North America, and there is very little to be gained by any of them calling CQ on this band under present circumstances. (Presumably they are enjoying summer short skip, though, and can work other South American countries—Ed.) Porto Rico stations were heard by G4MR and others on October 4, 6, 10, 20 and 24, and included K4ENT, EZR, FRN and GTH.

West Coast W's were not up to the standard of previous autumns, but a few W6's were logged on nine days between October 12 and 25. East Coast and Central district stations were more prolific and were heard at times varying from 13.00 to 22.00 g.m.t. though they were usually at their best in the early evening. G4MR logged U.S.A. police stations above 30 megacycles on October 14, 15 and 16, and comments on the large number of W5 amateurs audible.

Postscripts and Announcements

[*Continued from Page 72*]

cents. There is no guarantee on attendance required, and so far there is no intention of organizing a formal club, collecting dues, or having any sponsorship. It will provide a chance for many hams able to drop in, to "chew the fat" while chewing the starch—literally.

●

Deaf-Mutes Talk via Amateur Television

Two deaf-mutes have held the first sign language "conversation" by radio in New York by means of the pioneering two-way television circuit set up by radio amateurs between a Manhattan skyscraper and the Communications Building at the World's Fair, eight miles away.

Another remarkable television "first" was achieved during this broadcast when Dana A. Griffin, W2AOE, long-time radio enthusiast, received the sign-language images 17 miles away in the Northern Nassau Radio

Advertising Index

Club House at Williston, Long Island. He claims to have set a new DX record for amateur television reception.

The two-way television system utilized the new 1847 iconoscope tube developed by RCA.

The "talk" by the deaf-mutes was but one of the many experiments in television being conducted by the Fair's Amateur Radio Club during public demonstrations of the two-way system several times daily. Miss Bertha O'Donnell, of the Bronx, and Miss Adele Costa, of Manhattan, carried on the conversation in the sign language while interpreters stood by to unfold the talk to bystanders in both studios. The image definition was very good, viewers asserted, and the women "talked" with the same ease as if they had been in the same room.

Correction

In the article "A Safety Switch for V.F.O. Operation" in the January issue, the caption under Figure 1 should read:

". . . The shaded area indicates the portion of the insulating material to be mounted on the contact disc so that contact will be broken when the tuning condenser rotates the disc beyond limits of contact."

In other words, in the drawing the shaded area indicates insulation, while the white portion of the disc indicates metal.

New Books

[*Continued from Page 72*]

electrical workers, rubber matting, asbestos yarns and tape, asbestos roving, and cotton tape for electrical purposes. Five standards cover molded insulating materials, and five pertain to plates, tubes, and rods. There are procedures for testing electrical insulating oils including saponification number, and three other tests pertain to glass including pin-type lime glass insulators, glass spools, and electrical porcelain. Also included are the proposed specifications for rubber insulating blankets for use around electrical apparatus or circuits.

Other products covered include solid filling and treating compounds, untreated paper, and mica products. Six methods provide important standardized procedures for electrical tests: arc resistance of solid electrical insulating material, dielectric strength, power factor and dielectric constant, thermal conductivities of solid electrical insulating materials, conducting paths in electrical slate, and insulating resistance.

Several standards give tests and tolerances for woven glass fabrics, glass tubular sleeving and braids, and glass tapes.

Copies of this 340-page publication can be obtained from the American Society for Testing Materials, 260 S. Broad St., Philadelphia, Pa.

How to Choose a Slide Rule, by Don Herold. Published by Keuffel & Esser Co., Hoboken, N. J. 24 pages, 26 illustrations, 2 colors. Free upon request from the publisher.

This humorous publication explains for the first time the difference between the various types of slide rules available in straightforward, salty language. Although written primarily for students in the engineering colleges, this booklet contains slide rules information of interest to the entire engineering profession.

Buyer's Guide

• Where to Buy It

PARTS REQUIRED FOR BUILDING EQUIPMENT SHOWN IN THIS ISSUE

The parts listed are the components of the models built by the author or by "Radio's" Laboratory staff. Other parts of equal merit and equivalent electrical characteristics usually may be substituted without materially affecting the performance of the unit.

MOYNAHAN TRANSMITTER

Page 11

C_1—Hammarlund MCD-100-S
C_2—Johnson 100ED30
C_3—Johnson 100ED45
C_4—Johnson 50CD130
C_5, C_8, C_9, C_{10}—Cornell-Dubilier 4-11010
C_{13}—Eimac VC-50
C_{14}—Cornell-Dubilier 21A86
C_{15}—Aerovox PR-50
C_{16}, C_{17}—Aerovox 684
C_{18} to C_{20}, inclusive—Aerovox 484
C_{30}, C_{31}—G. E. 23F60
C_{32}, C_{33}, C_{34}—Aerovox PG
C_{35}, C_{36}—G. E. 23F64
C_{37}, C_{38}, C_{39}—G. E. 23F43
C_{40}—Aerovox PGM-250
C_{41}—Aerovox PR-100
C_{42}, C_{43}—Aerovox 684
R_1, R_{15}, R_{16}, R_{29}, R_{31}—IRC BT-1
R_2, R_6, R_{12}, R_{13}, R_{14}, R_{27}—IRC AB
R_3, R_{34}—IRC DG
R_4, R_5—IRC BT-2
R_7, R_8—Ohmite P-300
R_9, R_{32}, R_{33}—IRC EPA
R_{10}, R_{32A}—IRC HAA
R_{11}—Four IRC AG
R_{17} to R_{23}, inclusive, R_{25}, R_{26}, R_{28}—IRC BT-½
R_{24}—Centralab 72-121
R_{30}—Centralab 72-111
T_1—Kenyon T-3
T_2—Kenyon T-263
T_3—Kenyon T-468
T_4—Kenyon T-104
T_5—Thordarson T-70R62
T_6—Kenyon T-668
T_7—Thordarson T-19F90
T_8—Thordarson T19F88
T_9—Thordarson T-61F85
T_{10}—Special
T_{11}—Special
T_{12}, T_{13}—Kenyon T-382
T_{14}—Inca G-22
RFC_1—Hammarlund CHX
RFC_2—Hammarlund CH-500
RFC_3—Meissner 19-3019
CH_1, CH_2—Kenyon T-157
CH_3—Kenyon T-176
CH_4—Kenyon T-510
CH_5—Kenyon T-159
CH_6—Kenyon T-502
CH_7—Kenyon T-157
100TH's and RX 21's—Eimac
Tubes, except above—RCA

DAWLEY TRANSMITTER-EXCITER

Page 16

C_{1-5}—Cardwell Trim-Air
C_6—Cardwell MT-100-GD with JD-50-OS padder
C_{7-27}—Solar XM-6
C_{29}—Solar XM-25
R_1, R_3, R_4, R_5, R_7, R_8, R_9, R_{11}, R_{12}, R_{14}—Centralab 516
R_2, R_6, R_{10}, R_{13}, R_{15}—Ohmite Brown Devil
L_4—Bud RLS coils with AM-1339 base and adjustable link
6L6's—RCA
35TG—Eimac

PEAKED AUDIO AMPLIFIER

Page 23

C—Aerovox 1467
C_1, C_2, C_3, C_4—Aerovox type 434
C_5—Aerovox PR-25
C_6—Aerovox 484
C_7, C_8—Aerovox 1467
R_1, R_2, R_3—Centralab 710
R_4—Centralab 72-116
R_5—Centralab 710
S—Centralab type 1450
T_1, T_2, T_3, T_4—Thordarson 19F81
T_5—Thordarson 13S40 or 13S38 or 57S01
Tubes—RCA

VACUUM-TUBE VOLTMETER

Page 32

C_1, C_4, C_5—Sprague TC-15
C_2—Sprague TC-1
C_3—Sprague TC-5
C_6—Sprague UT-8
R_1—Centralab 514
R_2, R_3, R_4, R_5—Centralab 710
R_6, R_7, R_8—Centralab 516
R_9—Centralab 72-107
R_{10}—Ohmite Brown Devil
T—Thordarson T-13R11
BC—Mallory
S_1—Centralab 1401
S_2—Bud SW-1115
Cabinet—Bud 993
Chassis—Bud CB-996
Tubes—RCA

[*Continued on Page 97*]

The Marketplace

Classified Advertising

(a) Commercial rate 10c per word, cash with order; minimum, $1.00. Capitals: 13c per word. For consecutive advertising, 15% discount for 3d, 4th, and 5th insertions; 25% thereafter. Break in continuity restores full rate. Copy may be changed as often as desired.

(b) Non-commercial rate: 5c per word, cash with order; minimum, 50c. Available only to licensed amateurs not trading for profit; our judgment as to character of advertisement must be accepted as final.

(c) Closing date (for classified forms only): 25th of month; e.g., forms for March issue, published in February, close January 25th.

(d) No display permitted except capitals.

(e) Used, reclaimed, defective, surplus, and like material must be so described.

(f) Ads not relating to radio or radiomen are acceptable but will be grouped separately.

(g) No commissions nor further discounts allowed. No proofs, free copies, nor reprints sent.

(h) Send all Marketplace ads direct to Santa Barbara accompanied by remittance in full payable to the order of Radio, Ltd.

---

813 C.W. TRANSMITTER, 250 watts, described in chapter 16 of 1941 Radio Handbook, $75 less tubes, f.o.b. The Editors of Radio, Santa Barbara, Calif.

WRITE BOB HENRY—W9ARA for best deal on all amateur receivers, transmitters, kits, parts. You get best terms (financed by myself); largest trade-in; personal cooperation; lowest prices. Prompt delivery of all the newest apparatus like the NC-200. Write W9ARA, Butler, Missouri.

SEVERAL guaranteed reconditioned 350 watt JRA3 110-v. A.C. light plants at $45. Ideal for amateurs. Write Katolight, Inc., Mankato, Minnesota.

RECONDITIONED—guaranteed receivers and transmitters. All makes. Lowest prices. Free trial. Terms. New Howard 460s with crystals $59.95; SX-23s $79.50. List free. W9ARA.

NEW PRICE LIST—released. Splatter chokes, filament, Universal plate and modulation transformers. Complete line; write for list. Buy direct for less. PRECISION TRANSFORMER COMPANY, Muskegon, Michigan.

TRANSMITTING TUBES REPAIRED—Save 60%. Guaranteed work. KNORR LABORATORIES, 1722 North Pass Avenue, Burbank, California.

CHASSIS—standard or odd sizes. Panels. Cabinets. Racks. R. H. Lynch, 970 Camulos, Los Angeles, California.

BATTERY POWERED CONVERTER, 10-80 meters, described on page 144 of 1941 Radio Handbook, complete with tubes and coils but less batteries, $15, f.o.b., The Editors of RADIO, Santa Barbara, Calif.

CRYSTALS—in plug-in heat dissipating holders. Guaranteed good oscillators. 160M-80M at $1.25. 40X $1.65. 80 M vari-frequency (5 Kilocycle Variance) Complete $2.95. State frequency desired. C. O. D.'s accepted. Pacific Crystals, 1042 S. Hicks, Los Angeles, California.

RADIO KITS—$3.95 up. Single band; all wave. 5-10 tubes. Fluorescent lighting. Save 50%. Radio parts catalog—Free. McGee Radio. P-2015, Kansas City, Missouri.

COMMERCIAL—radio operators examination questions and answers. One dollar per element. G. C. Waller, W5ATV, 6540 E. Washington Blvd., Tulsa, Oklahoma.

ALNICO MAGNETS—They "float". Only 35c per pair postpaid. Satisfaction guaranteed. William D. Hayes. Box 1433, Oakland, California.

TRANSMITTER. POWER SUPPLY—6L6, 803, pair 852s 700 watts CW. Coils for 40-20. Sacrifice at $80. Detailed data and photos upon request. K. P. MacDowell. 2221 Lotus, Fort Worth, Texas.

LEO. W9GFQ—Offers the Hams more and a better deal always. Lowest terms, no red tape (as finance own paper) on all new and used equipment. Free trial, personalized service—write for 124 page Bargain CATALOG and get acquainted. Wholesale Radio Laboratories, Council Bluffs, Iowa.

TRANSMITTING HEADQUARTERS—on latest Stancor, Thordarson & other Kits—commercially wired at low cost. New 70 watt transmitter kits complete only $35.00. Speech amplifier modulator up to 80 watts $25.00—up to 150 watts $49.50. Easy terms. Write LEO, W9GFQ today.

RECEIVERS—New in original cartons—Howard 436's $29.95. Howard 460's with crystal $59.95—SX23's 79.50—Reconditioned types all makes lowest terms. Write to LEO W9GFQ for free list today.

QSL's and HAM STATIONERY—W8JOT. Box 101, Rochester, New York.

AMATEUR—Radio licenses, training in code and theory. Resident and home study courses. Hundreds of licensed students. American Radio Institute, 1123 Broadway, New York.

SELL 30 WATT PHONE TRANSMITTER—All band, with coils, tubes, antenna coupler, in cabinet. Fb rig, $65.00. Write W6RXA, 1029 Washington Street, Redlands, California.

Buyer's Guide

[*Continued from Page 96*]

ROTHMAN MEDIUM POWER TRANSMITTER

Page 38

C_1—Johnson 50J12
C_2—Johnson 35HD15
C_3—Johnson 35HD30
C_4 to C_9—Sprague type IFM
T—Thordarson T-19F99
R_1, R_3, R_4, R_5, R_6—Centralab 516
R_2—Ohmite Brown Devil
R_7—Ohmite slider type
Insulators & Hardware—Johnson
Tubes—General Electric

Yarn of the Month

[*Continued from page 68*]

The ham who makes a practice of repeating each sentence several times while trying to think up something else to say will find his Dialogue Meter going off-scale in the "No" direction, as will the one who states that he received an entire transmission perfectly and then proceeds with "OK on . . . , and OK on . . . . etc." It is surprising how easily the chronic repeater can improve his dialogue rating by writing down a few words to help him remember what he wanted to say without causing unnecessary interference by a lot of ". . . and . . . er . . ."

Public Menace Number One to the Dialogue Meter is not, however, the ham who can't recall what he had to say, but instead is the ham who talks too much when he really has nothing to say. This type of individual generally spends about half his time talking to the amateur he is in contact with and the other half addressing "his great unseen audience" in what he considers the best Broadcast practice. He tells his listening friends what a "pleasant contact he had with W . . . ," and whether it was "eighty-five percent perfect" or possibly "ninety-nine percent solid." Although these side remarks may be very interesting to short-wave listeners, they do not tell the operator to whom he is talking anything new, and neither that operator nor the Dialogue Meter approve. It is amusing to listen to the judicial tone and air of great personal importance assumed by some inexperienced or egotistical hams when they are on the air, but the meter is no more fooled by these indications of immaturity than are the amateurs on the band, and it registers twenty solid negative points for such conceit.

I am sure that there will be some who will object to the way this meter is adjusted because, "Hams are just talking to each other for their own pleasure, and it doesn't make any difference how well or how concisely they say what they have to say." However, I believe that the others who have to listen to the ramblings transmitted by these dissenters will even contribute to help buy meters for such individuals. As a matter of fact, I hope to convince the Federal Communications Commission that it is just as important for every phone station to have a Dialogue Meter as it is for them to have a frequency meter. Why not build—and *use*—yours today?

●

Didjano?

The first volume controls were filament rheostats.

For those who want the best

Ultra-high-frequency triodes

U-H-F oscillator, R.F. amplifier and detector having extremely low capacitances and short leads resulting in efficient operation up to 300 megacycles (1 meter).

HY615 $2.00 net

Heater . . . . 6.3 volts @ 0.15 ampere
Plate . . . . . . 300 max. volts & 20 max. ma.
Plate dissipation . . . . 3.5 max. watts
R.F. power output @ 240 mc. . . . . 4.0 approx. watts

HY114 $2.00 net

Low-drain filament-type triode for portable and mobile uses powered from batteries.

Filament . . . . 1.4 volts @ 0.12 ampere
Plate . . . . 180 max. volts & 15 max. ma.

Medium-power triode with cylindrical graphite anode, helical filament, vertical-bar tantalum grid. Provides unusually-high power output with minimum input.

HY75 $3.75 net

Filament . . . . 6.3 volts @ 2.5 amperes
Plate . . . . 450 max. volts & 100 max. ma.
Plate dissipation . . . . 15 max. watts

Output	Modulated	Unmodulated	
224 Mc.	14	17	watts
112 Mc.	19	24	watts
56 Mc.	24	33	watts

R.F. beam-power tetrodes

R.F. power amplifier, buffer, frequency multiplier, oscillator, Class AB2 modulator of exceptionally high power sensitivity. Fully shielded for R.F. — no neutralizing required.

HY61/807 $3.50 net

Heater . . . . 6.3 volts @ 0.9 ampere
Plate . . . . 600 max. volts & 100 max. ma.
Plate dissipation . . . . 25 max. watts
R.F. power output . . . . 37.5 approx. watts

HY60 $2.50 net

Low-power version of HY61 with reduced power drain — Ideal for mobile uses.

Heater . . . . 6.3 volts @ 0.5 ampere
Plate . . . . 425 max. volts & 60 max. ma.

Instant-heating tetrode

Instantaneous-heating filament type R.F. and audio tetrode for mobile and portable xmitters — no battery drain during stand-by. Shielded for R.F. Full plate input for phone and doubler operation. Also operates efficiently on AC.

HY69 $3.50 net

Filament . . . . 6.3 volts @ 1.5 amperes
Plate . . . . 600 max. volts & 100 max. ma.
Plate dissipation . . . . 40 max. watts
Nominal Class C output . . . . . . 42 approx. watts

Graphite-anode triodes

High-efficiency SPEER graphite-anode triodes for R.F. Class B and C amplifier, buffer, doubler, oscillator, Class B modulator.

HY51A-HY51B $4.50 net

HY51A filament . . . . . . 7.5 volts @ 3.5 amperes
HY51B filament . . . . . . 10 volts @ 2.25 amperes
Plate . . . . 1000 max. volts & 175 max. ma.
Plate dissipation . . . . 65 max. watts
Class C output at 75% efficiency . . . . . 131 watts

HY51Z $4.50 net

Zero-bias version of HY51A for all applications

Filament . . . . 7.5 volts @ 3.5 amperes
Class C output @ 75% efficiency . . . . 131 watts

HY40 $3.50 net

Filament . . . . 7.5 volts @ 2.25 amperes
Plate . . . . 1000 max. volts & 115 max. ma.
Plate dissipation . . . . 40 max. watts
Class C output at 75% efficiency . . . . . 86 watts

HY40Z $3.50 net

Zero-bias high-mu triode similar to HY40 in ratings — particularly desirable as modulator.

Filament . . . . 7.5 volts @ 2.5 amperes
Class C output @ 75% efficiency . . . . 86 watts

HY30Z $2.50 net

A real 25-watt transmitting tube with over-size graphite-anode and lava insulators — definitely not an overgrown receiving tube.

Filament . . . . 6.3 volts @ 2.25 amps.
Plate . . . . 850 max. volts & 90 max. ma.
Plate dissipation . . 30 max. watts
Class C output at 75% efficiency . . . 58 watts

Hytron transmitting tubes are fully licensed for protection of the buyer or user.

Mercury-vapor rectifiers

Half-wave mercury-vapor rectifier with internal shield to prevent bombardment of elements.

866 $1.50 net

Filament . . . . 2.5 volts @ 5 amperes
AC plate voltage . . . . 2650 max. volts

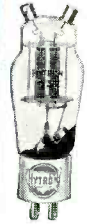
Two Hytron 866's will deliver up to 2385 volts DC at currents up to 500 milliamperes

Junior rectifier for light-duty applications with plate connection to top cap.

866 Jr. $1.05 net

Heater . . . . 2.5 volts @ 3.0 amperes
AC plate voltage . . . . 1250 max. volts
DC plate current . . . 250 max. ma. for two tubes

Twin triode



Instant-heating thoriated-tungsten zero-bias twin-triode for use as modulator in mobile transmitters — designed as a companion to the HY69.

HY31Z $3.50 net

Filament . . . . 6.3 volts @ 2.5 amperes
Plate . . . . 500 max. volts & 150 max. ma.
Plate dissipation . . . . 30 max. watts
Audio power output . . . . 50 watts

Above ratings are for both sections of tube.

Ceramic-base Bantams and 6L6GX

6A8GTX	converter	$ .95 net
6J5GTX	med. mu triode	$ .95 net
6J7GTX	r.f. pentode	$ .95 net
6K7GTX	r.f. pentode	$ .95 net
6K8GTX	converter	$1.30 net
6SA7GTX	converter	$1.05 net
6SJ7GTX	r.f. pentode	$1.05 net
6SK7GTX		$1.05 net
6L6GX		$1.25 net

Specially-selected tubes with low-loss ceramic base for use in high-frequency circuits. Interchangeable with metal and G types.

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A NEW RECTIFIER WITH A

LONGER LIFE!

RCA 866-A/866

HALF-WAVE MERCURY-VAPOR RECTIFIER

$1.50

Amateur Net

RCA engineering scores again! Not only does the new RCA-866-A/866 half-wave, mercury-vapor rectifier handle higher voltage at lower initial cost but its truly great life means even greater value for your money. Once installed in your rig you can forget rectifier tube problems for a long, long time to come.

This new tube supersedes the 866 and 866-A and may be used in equipment designed for these types. An exclusive RCA development, it combines the ability of the 866 to conduct at relatively low plate voltage with that of the 866-A to withstand a high peak inverse voltage—and, in addition, gives you a *plus* performance that makes it far and away the greatest rectifier value RCA has ever offered.

Unique New Filament Design Used in the 866-A/866

Secret of the 866-A/866 is another top notch RCA engineering achievement—an edgewise-wound coated ribbon filament, illustrated at right, of great mechanical strength and providing more cathode area for the same filament power rating. This filament utilizes a new alloy material that not only has tremendous electron-emitting capabilities, but also holds the key to greater life.

Important among other features of the tube is the special filament shield which makes practical the use of a very low starting voltage. A ceramic cap insulator and new dome-top bulb minimize danger from bulb cracks caused by corona discharge and resultant electrolysis.

Get more for your money! Make sure your new rectifiers are RCA-866-A/866's.

RATINGS

Filament Voltage (A-C)	2.5 volts
Filament Current	5.0 amperes
Peak Inverse Voltage	
Up to 150 cycles per second	10,000 max. volts
Up to 1,000 cycles per second	5,000 max. volts
Peak Plate Current	1.0 max. ampere
Average Plate Current	0.25 max. ampere
Tube Voltage Drop (approx.)	15 volts

SENSATIONAL PERFORMANCE

. . . at a New Low Price!

- **LONGER LIFE**—Assured by radically improved new filament, dome bulb and insulated plate cap.
- **HIGH RATING**—10,000 volts, peak inverse voltage. 1000 ma., peak plate current.
- **ENORMOUS EMISSION RESERVE**—Provides ability to withstand high peak loads.

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RCA

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